AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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The Universal Milling Machine.

"Necessity is the mother of invention." With equal truth it may be said that progress breeds new necessities. Thus by the action and re-action of one idea upon another, machine tools have emerged from an invisible point in the midst of a remote antiquity, from which, by a series of almost imperceptible improvements they have grown and spread outwards to the commanding position which they now occupy.

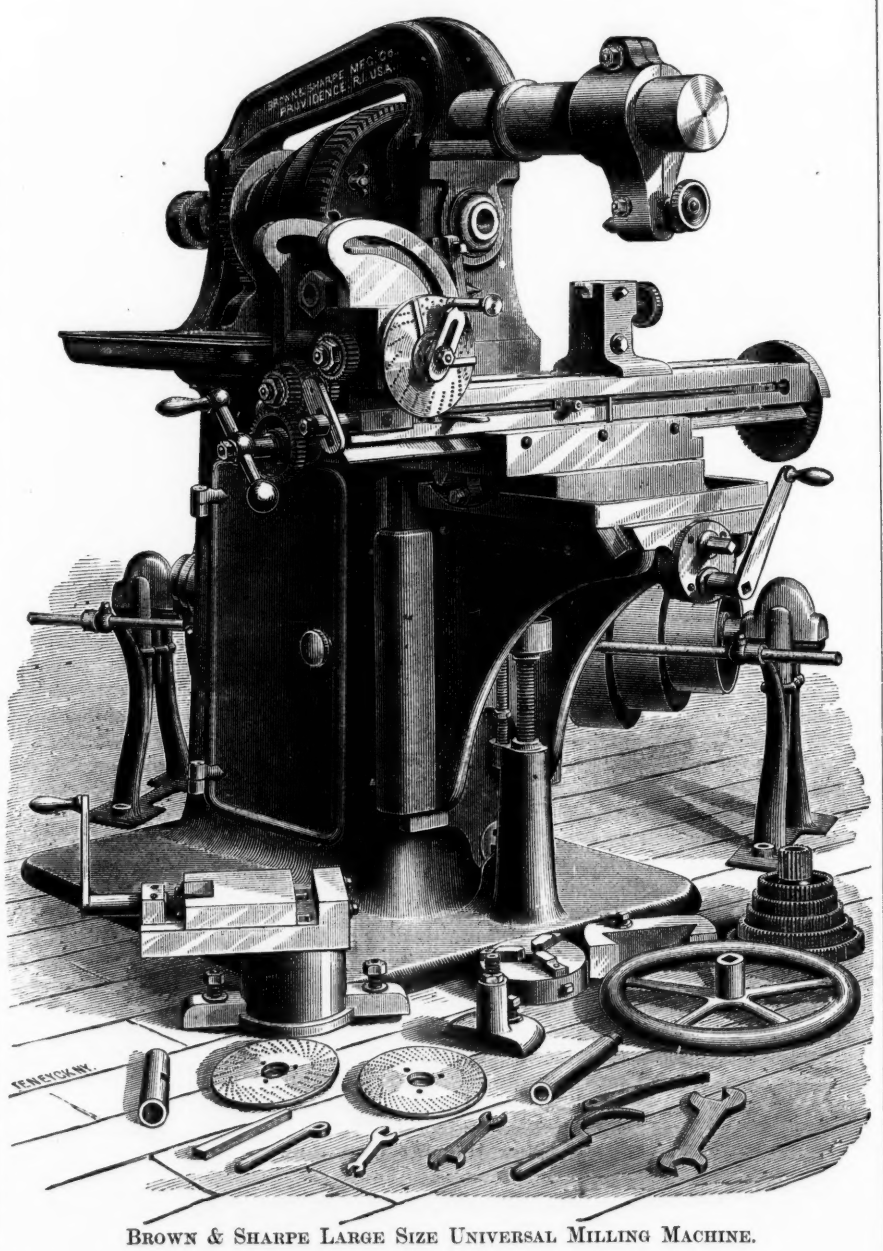
It may be doubted that any one machine tool occupies a more elevated position in the opinion of mechanicians generally than the "Universal Milling Machine;" it is, in fact, a producer of tools, for it would be difficult to find at this day a good machine tool works without one or more of these indispensable machines. Peculiarly American in its design and construction, the "Universal Milling Machine" has done more for the introduction and demand for American machinery in Europe than any other machine.

As exhibited by J. R. Brown & Sharpe in 1867, at the Paris exhibition, it attracted the attention of engineers, machine tool builders, gun and sewing machine makers, and the directors of government arsenals, and other large engineering works. It was one of those "special tools," by the aid of which, Americans have been enabled to so far improve the construction of their general line of machinery, that they were at once successful competitors for large orders of special and other machinery, for governments and other large industries. Europe from that time forward could not afford to be without the "Universal Milling Machine." Those sent for exhibition were sold, soon after the opening, to Continental machine tool builders, ostensibly for the purpose of using them as copies from which to build others; one firm being so anxious to obtain one of these machines that an order was telegraphed from the exhibition grounds to Providence. This in 1867 meant much more than in these days of "Cablegrams."

The workmanship on these machines was of such a quality that the purchasers found difficulty in producing others of equal character, except certain parts which were reproduced on these same tools; thus showing the imperative necessity of parent tools containing within their own structure the inherent qualities of truth and the highest excellence.

One of the minor virtues in a good machine tool is general convenience, easy access to the various parts, the arrangement of the handles for manipulation, and their being so combined that the attendant has not to waste his time in moving from the point of action in order to reach them. Another highly important point is that every tool should not only be sufficiently well made, but that the means of adjustment and compensation for wear should be such that the general soundness of the fitting can be maintained, and that the work produced by the machine during its lifetime shall be perfect, and require no filing afterwards. This is the true condition to be reached with tools, and this high standard is not within sight unless the tool have a combination of all the virtues which should characterize a machine tool in this age of special machinery.

At the Vienna exhibition of 1873, Continental tool builders exhibited their copies of the American Universal Milling Machine, and Revolving Head Screw Machine "System Brown & Sharpe," (so noted in the illustrated catalogue of one firm.) Decidedly the best copies of these machines were those exhibited by the Alsatian firm of Ducommun & Stehelin of Mulhouse.



BROWN & SHARPE LARGE SIZE UNIVERSAL MILLING MACHINE.

At this exhibition, however, preference was given to the tools exhibited by Brown & Sharpe, and the consequence was that their tools were sold earlier and at better prices than the copies, some of which were very creditable.

Excellent reports spread as to the great advantages obtained by the use of these "special" American tools, notably the Milling Machine. Agents of Continental Governments had been sent to this country for the purpose of examining and reporting upon our "Special Machine industry," and it is not too much to say that machinery to the value of several millions of dollars was soon exported from the United States to Europe, due very largely to the liberal exhibit of such machinery by Brown & Sharpe at Paris in 1867, followed by similar exhibits of the same and other firms at Vienna in 1873. The writer is cognizant of the fact that a Continental Machine tool firm visited our Centennial exhibition and purchased "Sample" machinery to the value of $30,000, for the avowed purpose of re-production.

The late Paris exhibition was especially rich in creditable productions of machinery of American origin, very notable among which were copies of the Brown & Sharpe Universal Milling Machine.

These were exhibited by several tool builders in the French section, as also by a prominent English firm in the British section, who were considerably chagrined at the reply of the International Judges, who, in answer to their appeal for an award higher than the Silver Medal (of which they had received notice), informed them that with machinery as with fine arts, "Copies were not entitled to so high an award as were the originals."

No gold medal awarded was more deserved than that given the Brown & Sharpe Manufacturing Company for their fine exhibit of special machine tools, many of which have become the standard tools, from which Continental and other firms are now constructing their copies.

It is a very complimentary fact for this Company that notwithstanding the fact of Universal Milling Machine "Copies" being exhibited in the French section—the two (one large and one small size) sent by Brown & Sharpe, were sold to remain in Paris. The large one exhibited at the "Centennial" was sold to the well-known Prussian firm of Fried. Krupp, at Essen, Prussia.

The engraving on our first page exhibits the large size Brown & Sharpe Universal Milling Machine, which has been designed especially to meet the wants of steam engine and locomotive builders and others engaged in the manufacture of heavy machinery.

The essential features and motions are the same as in their smaller universal milling machine, with such enlargement of the whole machine and its parts as would best adapt it for the class of work to be done. The cone has three diameters, each 3½-inch face. In addition, the cone is strongly geared, thus making six changes of speed. There are, also, the same number of changes of feed.

The spindle boxes are of hardened steel, and, together with the spindle bearings, are carefully ground, and are provided with means of compensation for wear. The spindle will carry a cutter arbor projecting 15 inches, which is supported by an adjustable center at the outer end. Cutters of 8 inches or less diameter can be used. The horizontal movement of the spiral clamp bed upon the knee in a line with the spindle of the machine is 6½ inches, and the vertical movement of the spiral bed centers below the spindle centers is 11 inches. The spiral bed can be set at angles of 35° each way from center line of spindle, and can be fed automatically 22 inches, taking also 22 inches between the centers and will swing 11½ inches.

The hole through the chuck and spiral head is 1½ inches.

The vise jaws open 3⅜ inches, and are 6 inches wide, and $1\frac{5}{16}$ inches deep. Accompanying the machine are change gears for cutting spirals, index plates, Horton's Special Chuck, hand wheel, stop rest, collet, wrenches, together with complete overhead works, with adjustable self-oiling hangers, shipper, stud, stop, &c.

The pulleys on counter shaft are 16 inches diameter, and the whole width of the three equals 22½ inches. The counter shaft should run 105 turns per minute.

The weight of the machine complete in one box is 3,800 lbs.

One important point of superiority of these machines, is that in the cutting of spirals or any work which is being done upon the centers, the "back lash"—a prolific source of error in workmanship—is reduced to a minimum by the construction and connection between the feed screw and "spiral head," and is never more than is caused by the wear between the worm and worm wheel for which means of correction are provided. In some machines of a similar construction the "back lash" of all the gears connecting the spiral head and feed screw is communicated to the work being operated upon. This machine is complete when sold, there being no need of buying extra attachments in order to cut spirals.

For further particulars address, the Brown & Sharpe Mfg. Co., Providence, R. I.

New Upright Drill.

The object of the designer and builder of the New Upright Drill shown in the accompanying illustration has been to produce a machine for drilling, strong, convenient and perfectly true in its operation, with quick return feed—in short, a tool such as the great majority of machine shops require where facilities for rapid and reliable work are valued more highly than outward polish and ornamentation. The general construction may be seen at a glance. The quick return feed, one of the most important features of a drilling machine, is entirely new and is claimed to be superior to anything else of the kind known to machinists. The operator moves the handle with his right hand, his left hand being free to reach the work while standing in the natural and most convenient position to manage the machine. One and a half revolutions of the handle raises or lowers the drill its full distance. It is simple and positive, and can be operated instantly. The ease and rapidity of drilling by means of this device (on which a patent is now pending) make it worth the attention of machinists everywhere. There are four sizes of these drills made, all being exactly alike in every other respect. They are 20 inch, 24 inch, 28 inch and 32 inch. They have steel spindles, counter-balanced by weight inside the columns. The tables are adjusted to height by a rack and pinion swing around the column also turns in the arms. The bases are planed square with the column. The manufacturer, H. Bickford, 179 East Front St., Cincinnati, has fitted up a shop for the purpose of making upright drills an exclusive specialty, and is in position to build them at as low prices as good tools can be obtained for. He has had a life-long experience in the line of machinery. Quite a number of his drills are now in use, giving the best satisfaction.

Engine Duty and Indicater Cards.

Editors American Machinist:

Remarks in one of the letters in January Machinist suggest the following:

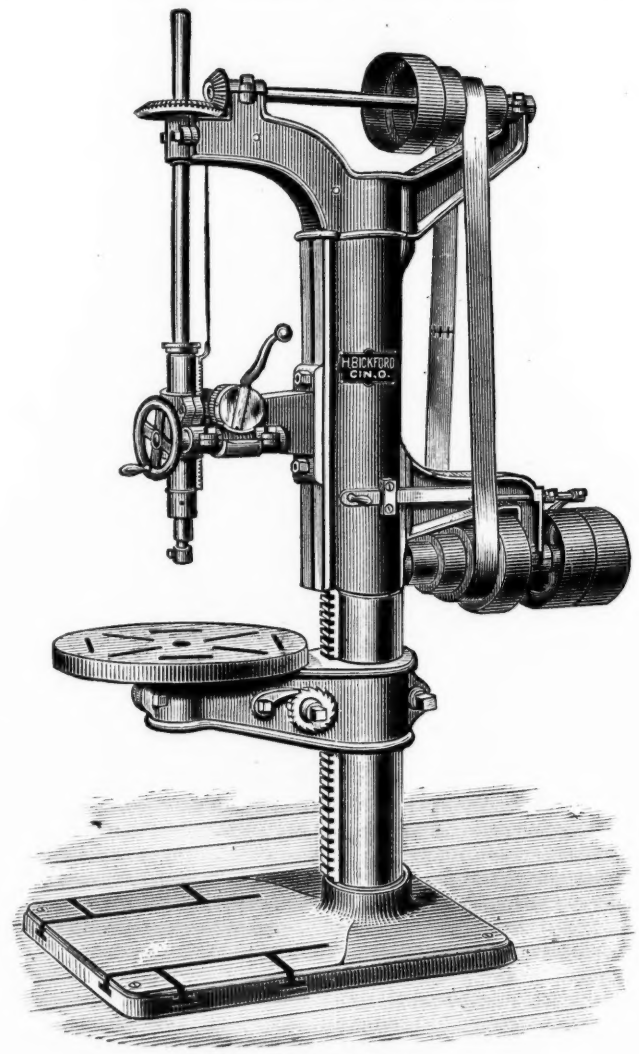
In reference to water accounted for by indicator diagrams, if your correspondent has had much experience in comparing such accounting with actual weight of water forced into boilers, he could not have failed to notice that there is always a considerable quantity of the water unaccounted for; just how much of this discrepancy is real and what proportion is only apparent, depends of course on the accuracy of the means employed for measuring or weighing.

To arrive at a knowledge that shall be sufficiently correct to be worth any thing, of the temperature and weight of water fed into boilers, requires a close attention and reliability of apparatus not generally appreciated.

The chances of error in the statement of results are somewhat increased by the fact that the conclusions reached are expressed in terms of H. P. per hour, while the records of measurement are *generally* made but a few minutes apart; to this add the unavoidable though small leakages of water and steam all the way from feeding appliance to stuffing boxes on engine, and in a trial of sufficient length to ensure desirable data, there may be quite a margin of allowance to be made above what the "cards" will show. It is probably impossible to operate a steam cylinder (even when dry saturated steam is used) in such a manner that some considerable water will not be carried off by condensation due to expansion and contact, unless a certain condition is satisfied, and that condition in general practice is very seldom fulfilled, viz. employing a steam jacket and having the *proper quality* of steam both in the jacket and cylinder; even then, condensation from jacket must be returned to boiler without loss of water.

After these requirements are observed still another element, it will be seen, enters to put us astray, and that is loss of heat by radiation in transfering steam from boiler to engine, in returning hot water from jacket and again heat carried off by exhaust steam above that due to its pressure.

In regard to the Pawtucket pumping engine, your correspondent in giving results, does not mention whether or not he has included in his calculations, diagrams from the receiver and waste room between the cylinders; if he has not, of course there is something yet to hear from; and again, the two weeks test included all fuel used for banking fires at night and starting fresh fires each morning. This method of weighing fuel is a step in the direction towards the establishment of what might be called the "commercial duty" of pumping machinery, or a duty by which a buyer is to judge of the efficiency of apparatus as compared with the *total* cost of fuel consumed in producing the results demanded; but however it can scarcely be called correct to charge against the engine, fuel burned while the machinery is at rest, in making comparisons of indicator diagrams (produced when the engine is thoroughly heated and under full motion) with the consumption of coal in the furnaces.



NEW UPRIGHT DRILL.

A proper allowance in this direction would still further reduce the difference between 1.08 and 1 74; also, is the 9.5 pounds evaporation a guess or a fact? Upon the accuracy of a value placed for evaporative power of the boilers rests the certainty of the whole comparison.

As to the "Hope station" engine; just how sharp sighted a superficial observer might be is a nice point to determine; but, anyone with a good eye for proportion could not fail to notice the extreme height of terminal pressure as compared with initial pressure and point of cut-off, especially at slow speeds. Another superficial observer might think the steam valves leaked if he did not happen to know better, and still another very possibly would remark that a steam jacket (as successfully utilized as at Pawtucket) would be worth more than the cut-off, but however that may all be, there is no room to doubt that the very low average piston speed gave ample time for a thorough evaporation in the cylinder, at the expense of course of the cylinder heat, this eventually resulted in the robbery of heat from initial steam and added direct condensation to that due to work performed by expansion, so that the steam at point of cut-off was well charged with moisture all ready to appropriate caloric belonging to the iron as soon as the pressure should fall, and carry it away to the condenser, the difference then, mainly between "Hope station" and Pawtucket engines, is that of the amount of heat given off by fuel in the furnaces, a much larger amount was transformed into mechanical work in the latter than in the former case.

The expansion of steam to twenty volumes (about the grade at Pawtucket) in unjacketed cylinders, however well protected from external radiation, would probably produce results far short of the best economy.

And now, in conclusion, comes the question as to how much the compound principle in Pawtucket engine, contributed towards the very satisfactory duty obtained. The builder of that piece of machinery undoubtedly possesses means unequaled in the country, for arriving at a correct knowledge of best conditions for operation of steam machinery, the selection by him of a compound engine for obtaining (presumably) best possible duty, is a strong argument in favor of expanding steam through more than one cylinder: but, nevertheless, the absence of direct evidence under *precisely similar conditions* in support of two independent cylinders with connections to one shaft, and generally similar in arrangement to this compound machine, leaves the question still open as to which plan would yield the highest duty; the expansion through and contact with the receiver would be avoided at least.

Although a direct connection of steam piston and pump rods is secured, a large portion of work is actually done through balance wheel and connections, in consequence of the extreme difference between initial and terminal pressures on one hand, and (when supplying a reservoir) the nearly uniform resistance offered by water pressure to plungers on the other; and further, it would seem reasonable to suppose that the weight of reciprocating parts, with independent cylinders, could be proportioned to operate without shock, especially when moving at tolerably high piston speed that could be obtained.

Comparisons between compound and single cylinder engines have generally been indiscriminate, and the almost complete absence of the only means by which a reliable competition could be obtained, viz: operation, under similar conditions, has greatly aided to defeat efforts at sound judgment on the subject.

Now at Pawtucket we have a specimen of the compound principle producing unparalleled results in high duty, and if its maker is as good at avoiding self-deception as at building steam engines, the argument is well nigh unanswerable.

Respectfully yours,

CHA'S. A. HAGUE,
407 West Monroe Street,
Chicago, March 10th, 1879.

Engineering Popularized.
No. (IV.)

Messrs. Editors:

In looking over the notes which I have been accumulating from time to time, I find a great many odds and ends of engineering practice, more or less interesting individually, but having no especial connection. Hence, I propose in this, and possibly the following articles, to disregard any particular sequence of ideas, and instead to note, in a few disconnected paragraphs, some of those points which have not yet become trite.

WHY SHOULD THE CURVES BE RUN BACKWARD?

that is, commencing at the point of release, as heretofore described, instead of commencing at the point of cut-off and running downwards as is customary with many engineers.

Suppose you were a ticket agent on the New York "L." In the morning you are given 1000 tickets which are duly charged to you. At night you render up 100 unsold tickets and a sum of money. The collector, noting the 100 unsold tickets sees that he is *entitled* to $90 in money, and the cash must account for it. If it don't you are quite likely to be asked, "why is this thus?" Which is precisely the case with our engine. The 1000 tickets represent the work *resident in* the admitted steam at the point cut-off. The amount of pressure remaining at the instant of opening the exhaust—the pressure of release—being the amount of unused pressure, corresponds to the 100 unused tickets; and the cash is the work done by the steam—in strict analogy, the work of *expansion* only, prior to the surrender of the unused pressure remaining. Hence, as with the ticket agent, having measured the pressure *rejected*, we know at once how much work we were entitled to. If the cylinder has surreptitiously obtained any steam, either by smuggling it in as condensed water, and afterwards re evaporating it, or by stealing it bodily in the way of leakage, it is bound to turn up in that fatal pressure of release—the adiabatic curve draws its rigid line, and the diagram failing to account for the work due the deficiency—or "knock down" to carry out the simile—is at once detected. On the other hand, to commence at the point of cut-off to run the curve, would be something like counting out 1000 tickets with great care in the morning, and at night raking in cash and tickets indiscriminately, without any kind of a tally. I don't pride myself particularly on the analogy, but it will do to illustrate the reasoning. Moreover, even if it were theoretically correct to run from the point of cut-off, that point cannot be absolutely determined in one card out of fifty while the point of release is generally pretty plain.

And this leads me to speak next of

THE VALUE OF SHARP CUT-OFF,

because some builders who are justifiably very proud of a decisive rectangular corner, rather exclaim against any criticism which doesn't radiate from that corner as the center of all excellence. Take a rounded corner as *a b* in the Fig., which is a fair average sample of cut-off. What do we lose by it? Why, just the ratio of the little three-cornered area *a k b* to the whole area of the card;—in this case just ½ of 1 per cent. But it happens furthermore that to secure such a cut-off, either an extreme length of port, or a very reduced lap is indispensable, either of which lays the case open to the inevitable and great evil of leakage, sooner or later—a loss overbalancing the gain from sharp cut-off ten,—oftener fifty to one. In this connection, permit a word about

VALVE LEAKAGE.

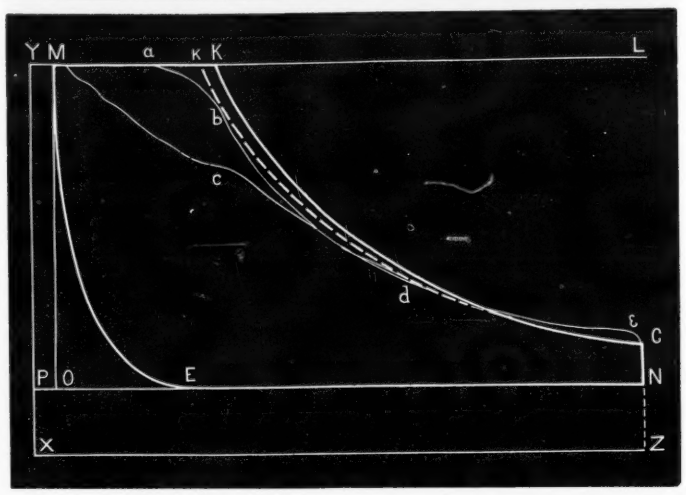
I remember one engine, and a grand good one too, which had an aggregate length of

port of 21″ covered by a lap of barely $\frac{3}{32}$″! I would ask any mechanic how long he would expect to defend such a frontier as that against leakage under those circumstances. Every engineer knows that in the vast majority of cases it is not the wear of the moving surfaces on each other, but the cutting of the steam itself which is to be feared. Once start a minute leak and the steam will soon eat away all semblance of tightness. But when controlled by proper conditions, the motion of the valve on its seat will tend to a constant and definite increase of tightness—if such a phrase be permissable. These conditions appear to be flat and reasonably extensive-bearing surfaces,—pressure largely reduced by balancing; proper lubrication, and above all *a constant length of travel*, to avoid shoulders on the valve seat:—result—a surface like a mirror and "bottle tight." I know one engine, and a small one too—only 10″ × 18″—which has now been running some years, and whereas at first its curves showed very considerable leakage, it has been gradually and constantly improving, one end of the cylinder always showing a little better than the other until now the best end draws the adiabatic curve beautifully every time, and the other end a curve about intermediate between the adiabatic and isothermal. Where the construction of the engine admits of it, the valves should always be scraped in under steam, which process though expensive, by compensating for the alteration of shape in the valve and cylinder by expansion from the heat, secures at once an even bearing, and prevents cutting, both from bearing hard in spots, or from the steam.

The theory of

CONDENSATION AND RE-EVAPORATION

has been made to account for the extra steam which so often shows up in the terminal pressure, to a degree not at all warranted by common sense. The fact of the matter is, if we would only own it, that this mighty handy theory has been calked in by main strength to stop the leak in many a valve. While the fact of the existence of condensation and re-evaporation cannot for an instant be denied, it is simply absurd to make it father the excessive terminals which we so frequently encounter. The best experimental data which we have, show the interior condensation of steam cylinders, unjacketed, and under the ordinary working conditions, to be about 20 lbs. of water per sq. ft. of interior surface per hour. Now let us figure a little. Suppose a cylinder 16″×32″ cutting off 80 lbs. steam at $\frac{1}{3}$th stroke, and making 100 revolutions per minute, developing thus 112 H. P. Without indicating every step of the calculation here, we find the interior surface, including ports and heads, to be in round numbers 2100 sq. in.—to be liberal say 14 sq. ft. exposed at each semi-revolution. The *time* of such exposure is $\frac{.1}{2\times100\times60}$=.00008 of an hour, during which time we should have condensed .00008×20×14=.0224 lbs. water. Suppose now re-evaporation to commence immediately after cut-off and to continue until release, at which time *all* the condensed water is re-evaporated By the law of expansion the terminal pressure for the given pressure and cut-off should be 19 lbs. above vacuum, occupying the total volume of the cylinder, viz: 6400 cu. in. .0224 lbs. of water is almost exactly .6 cu. in. which would make 768 cu. in. of steam at 19 lbs. pressure, which added to 6400 gives 7168 cu. in. of steam at 19 lbs. absolute pressure. Compress this now into 6400 cu. in. of space, and we would have as the increased terminal pressure due to the evaporation of the condensed water $\frac{7168\times19}{6400}$=12.2 lbs; an increase of barely over 2 pounds—and this too under the most aggravated suppositions. Yet how often do we find the terminal pressure from 4 to 10 lbs. higher than the law allows? Why in about seven automatic engines out of ten;—and isn't it simply nonsense to talk so glibly about condensation and re-evaporation? It sounds very learned but it won't work, and the quicker we own up that valves as generally made will leak in spite of all we can do, the quicker we will get on the right track. The conditions described above seem to be both in sense and fact the only ones which will establish a decided tendency towards increasing, and finally absolute tightness by use. That this *is* a fact of practice, the writer has had abundant opportunity to verify.



The above calculation is not physically accurate, since no account is made of the variation of temperature with varying grades of expansion. Of course the greater the difference between the temperature of the entering steam, and that of the surfaces with which it comes in contact, the more rapid the condensation. Hence we would expect to suffer more severely from this cause in the case of very early cut-offs. Why? Suppose our engine cutting 80 lbs. steam at $\frac{1}{3}$ stroke. The steam at the instant of cut-off would have a temperature of 324°. It commences to cool immediately after cut-off—cools considerably during expansion, and quite rapidly during the return or exhaust stroke, being re-heated by the half cylinder full of entering steam on the next stroke.

Now suppose the same engine cutting off at $\frac{1}{10}$th stroke. What is the comparative statement of the two cases, considering one side of the piston only? Case 1st. The cylinder is heated for $\frac{1}{3}$ stroke, cooled for $1\frac{1}{3}$ strokes, and re-heated by $\frac{1}{3}$ a cylinder full of steam. Case 2d. The cylinder is heated for $\frac{1}{10}$th stroke, cooled for $1\frac{9}{10}$th strokes, and re-heated by $\frac{1}{10}$th of a cylinder full of steam. Do we not see at once that the earlier the cut-off, the more the cylinder cools each stroke from the greater length of *time* it is exposed to the cooling action of expansion and exhaust, and the less the quantity of steam which has to furnish *all* the heat to reheat it? So of course this small quantity of steam suffers more by condensation during admission, and is more completely evaporated at the expense of the heat in the cylinder walls, owing to the longer duration of expansion, and the greater reduction of pressure accompanying it. Condensation and re-evaporation shows on the card by a fall of pressure more rapid during the first part of expansion than the true curve, and less rapid during the latter part, as shown by the fine line *b d e*. The tightest engines will exhibit this feature inevitably with extremely early cut-offs, and it is in such circumstances that condensation and re-evaporation becomes of serious importance, which leads at once to the two most vital questions of the proper size of engines, and the value of high rotative speeds, which we will examine next month.

In connection with the above Fig., I wish to say that when the card shows, not a fairly rounded cut-off corner, but a steam line dragging down rapidly from the beginning of the stroke, as M c d, the fault is not a wiser drawing cut-off, but a much more serious one, namely, insufficient size of ports or steam pipe, and by and by we will see how to discriminate between them and what is the remedy.

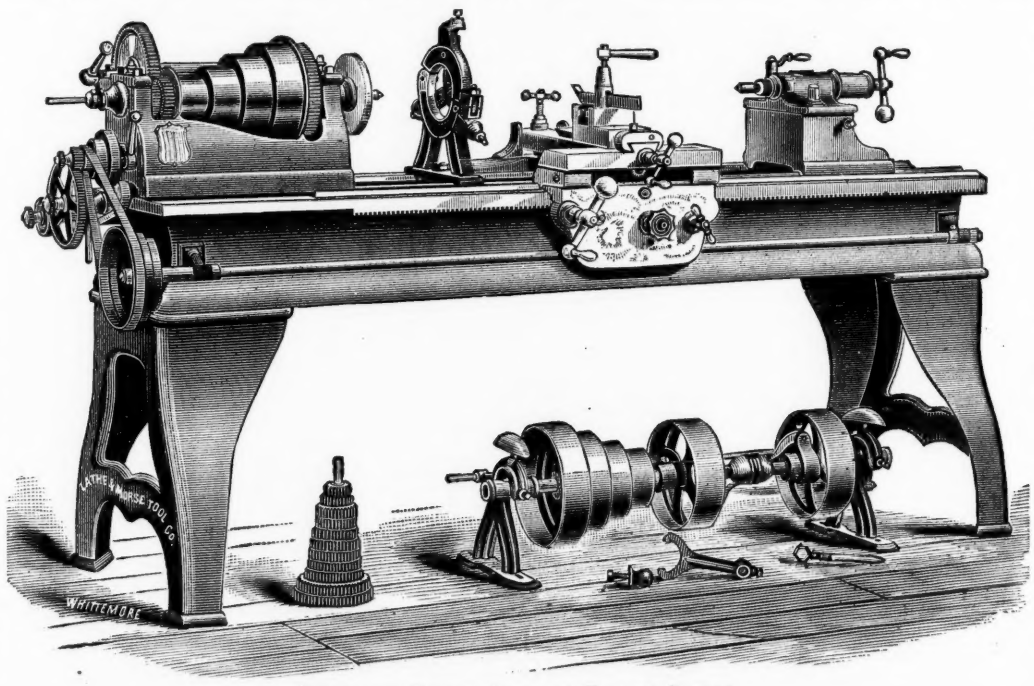
I am reminded to say before closing that in discussing water consumption in the last number, after giving the method of computation, I neglected to state what was first class economy of water, so that we might have a standard of comparison. With an engine of over 12″ bore, steam at 75 lbs. or over, and a load corresponding to a cut-off of about $\frac{1}{4}$th to $\frac{1}{3}$th stroke, we should expect as follows:

Non-condensing without compression .....21 to 23 lbs. water.
Non condensing with initial compression.....19 to 21 " "
Condensing..... 14 to 16 " " "

I have given the standard economy without compression because the valve gear of some engines does not admit of much compression, and the determination of the gross water, uncorrected for compression, is the test of the perfection of the valves and the consequent expansion.

I notice several typographical and proof errors in the last number, but any one who did me the honor of reading it understandingly, would readily see and correct them without the necessity of specifying them here.

WM. LEE CHURCH.



IMPROVED SCREW CUTTING ENGINE LATHE.

Improved Screw-Cutting Engine Lathe.

The illustration on this page represents a new style and design of 17-inch swing screw-cutting engine lathe, built by the Lathe and Morse Tool Company, Worcester, Mass. This lathe is from new patterns, is heavy, substantial and well proportioned in all its parts. The bed is extra wide and all wearing bearings long. It has rod feed and screw-cutting attachment separate, and the screw has open-and-shut nut.

Has lock gib rest with cross feed.

The cross feed and direct feed cannot be engaged together, thereby preventing many accidents. It has hollow-head spindle, $\frac{9}{16}$″ hole, giving long bearing for spindle in front box, and facility for driving out the center; also, opportunity for making small screws and parts from end of rod running through the spindle. The centers are extra long, with slow taper, making it very desirable for holding drill-sockets, mills, and other tools. The head cone has four changes, for $2\frac{1}{2}$-inch belt, with spindle bearing $2\frac{1}{4}$ inch diameter, and $3\frac{1}{4}$ inch long. The *diameter of cone and gears*, the size and length of bearings, and the wide belt used, make this a very strong machine.

Screw-cutting Lathes are furnished with friction counter-shafts, if desired.

The Lathe and Morse Tool Company have long had an enviable reputation for building first-class machinists' tools. This lathe is also kept for sale at the extensive machinery warerooms of their Boston Agents, Hill, Clark & Co., 36 and 38 Oliver street.

The Largest Locomotive Works in the World.

BY STEPHEN ROPER, ENGINEER.

Messrs. Editors:—

At your earnest solicitation I have reluctantly consented to write a series of articles on some of the great mechanical industries of Philadelphia. I am sorry this duty has not been entrusted to some one more able and competent than your humble servant, nevertheless a man never knows what he can do till he tries, and it is to be regretted that the world knows so little of the history of the men who, in every age, have tried. If I should fail to do justice to the subject under consideration, I am sure the readers of the MACHINIST will not lay the blame on my shoulders, but rather on those by whose inducements I was persuaded to undertake the task.

The Baldwin Locomotive works are undoubtedly one of the most extensive in the world, and are capable of turning out more finished work in a given time, than any three of the largest establishments of the same kind on this continent. They were established on their present site in 1832, by their founder, M. W. Baldwin, and then consisted of one narrow three-story building, fronting on Broad Street, between Buttonwood and Hamilton, and giving employment to about twenty "hands," their capacity at that time being about two small locomotives in a year. At present, the shops cover an area of over ten acres, extending on Broad from Willow to Spring Garden, and from Broad nearly to Eighteenth, along Willow, Buttonwood and Hamilton Streets, a distance of nearly half a mile; giving employment, in good times, to 2,900 men, requiring the additional labor of over 1,000 more, in other establishments, to manufacture the material consumed; the weekly pay-roll often amounts to over $50,000. The magnitude of the work executed may be more fully realized by giving a partial list of the quantity and character of the material consumed annually:

Coal, 20,000 tons; coke, 50,000 bushels; charcoal, 6,000 barrels; bar iron, 3,200 tons; iron boiler plate, 1,200 tons; steel boiler plate, 800 tons; pig-iron, 6,000 tons; steel tires, 2,500; chilled wheels, 5,500; copper, 200 tons; spring steel, 175 tons; lead, 65 tons; tin, 30 tons; spelter, 25 tons, and brass, 150 tons.

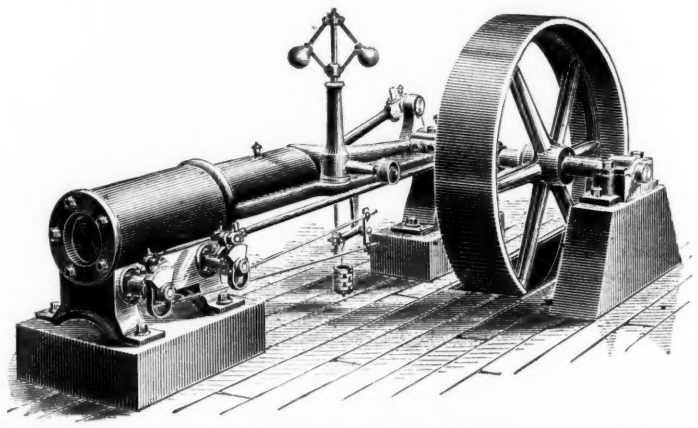
It would be almost impossible to describe the capacity and extent of these enormous works, because no description, however elaborate, would hardly do them justice. To be realized they must be visited, and all the various operations witnessed. There may be seen the operation of converting scrap-iron of every description into shapely forms to meet all the requirements of the different parts of a locomotive. Here, also, may be observed over 300 blacksmith's forges, throwing out volumes of Vesuvian sparks, many of them requiring five helpers to assist the blacksmith; besides seventeen steam hammers of various sizes and weight of stroke may be seen in operation; and, as the works cover so much ground they require fifteen stationary steam engines, located at different points, to furnish the power for the different shops. Here may be witnessed the powerful hydrostatic wheel presses, exerting a pressure of from three hundred to five hundred tons per square inch, in the operation of forcing the driving wheels of locomotives on their axles.

Here, also, may be seen enormous steam riveting machines and squeezers delivering their powerful blows in quick succession on the riveted seams of locomotive boilers; and also steam traveling cranes, which, at a signal from the workmen, lift the largest locomotive boilers with apparent ease, carry them to any desired point, and deposit them wherever required.

Large locomotives attached to trains may be seen moving through the different shops, delivering material, or taking on freight, without any inconvenience, and without interfering with any other operation; and, also, long files of mules, frequently as many as fifty, with their clanking dray chains, may be observed stalking into the workshop, preparatory to measuring their rugged strength with a train of large flat platform cars, containing several heavy locomotives ordered by some foreign corporation or government. At the present time there are nine powerful locomotives standing on the construction tracks receiving the finishing touches previous to be shipped to different parts of the world. Every known mechanical device for the transmission of power may be witnessed in full operation in these works, and if the visitor can spend the time, and manifest sufficient interest in such things, he may witness the movements and mechanism of over 700 different machines employed in the establishment; for forging, shearing, bending, punching, planing, turning, shaping, jigging, grinding, polishing, etc. This will, no doubt, impress him with the idea that it is no wonder that that personification of human intellect and brute force (the locomotive) has exerted such a powerful influence on the civilization of mankind, considering the amount of mechanical genius employed in its construction.

Up to January the first, 1879, there were 4,512 locomotives built at these works, which command prices, according to their weight and power, ranging from $3,500 to $34,000. Taking them at an average of $12,000 each, the market value would be $54,144,000; during which time the company paid out for labor in their shops nearly $20,000,000. The largest number of engines built in any one year was in 1873, when 500 were turned out; making an average, for every week during the year, of nearly ten locomotives. For the past five years locomotive building, like nearly all other industries, has suffered from the depression of trade, but it is very gratifying to state that the works at the present time, and for several months past, have been doing a good business, and giving employment to 2,000 men, day and night. The locomotives built at these works have been exported to nearly every part of the civilized world: Russia, Finland, Austria, Switzerland, Canada, Nova Scotia, New Brunswick, Mexico, South America, Cuba, Turkey, Egypt, Australia, New Zealand, New South Wales, India, China, and Japan, and in all cases have given entire satisfaction to the purchaser. In fact, the reputation of the locomotives built at these works stands very high all over the world for durability and efficiency. It was asserted that the inhabitants of Cincinnati became so skillful in the manipulation of the carcass of the hog, that they utilized every part of it, and even the "squeal" they converted into the whistle for locomotives. But such is not the custom at the Baldwin Locomotive works; their whistles have a clear sonorous sound, resembling the ring of the "Bland Dollars."

At these works, as well as at all others where any specialty in the machinery line has been brought to great perfection, everything is made to standards, and (like guns, pistols, and sewing machines) are all duplicated, so that if an accident should happen to any adjunct of a locomotive, in any part of the world having telegraphic communication with Philadelphia, the next express or steamship that leaves the city would carry out the duplicate of the injured part which would be sure to fit into its place with as much accuracy as if it was repaired at the works.



THE TWISS PATENT AUTOMATIC CUT-OFF ENGINE.—BACK VIEW.

The company is now very extensively engaged in the manufacture of "Motors" for elevated and street passenger railways, which have the reputation of being superior to any other now in use.

Now it would appear to most persons that, on account of the great extent and immense area of these works, they are unwieldy, straggling, and that everything is confusion and bustle, but the reverse is the case, as every operation goes on as smoothly and as uniformly as if it was a dry goods store. No piles of lumber or material lying round out of place, no mistakes or misunderstanding among the hands, no portion of them hindering or waiting for the other, and every man at his bench, his vise, or at his own special work, every machine in active motion, mutely, though accurately, fulfilling the specialty for which it was designed and inspired, as it were, with the intelligence and experience of the mechanics by whom they are controlled. Owing to the magnitude of the establishment, a stranger would naturally suppose that it would require almost a regiment of Bosses and any amount of "bossing," but such is not the case by any means. There are very few lookers-on to be seen in the shops; every command is conveyed by a signal, or a kind word, and responded to with alacrity. The proprietors, superintendents, foremen, gang, and track bosses, all work themselves, so that there are very few, if any, drones in the hive.

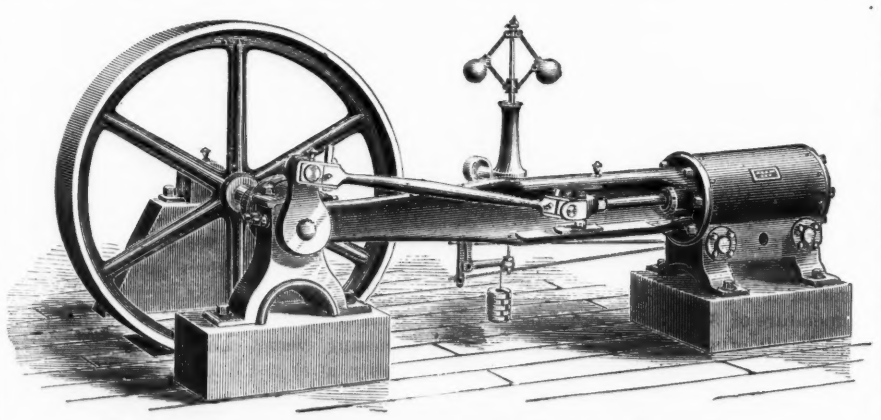
A fact that should be generally known and which redounds to the credit of the company is, that in the most trying times they have never failed to meet their obligations to their workmen, or to anyone else, and have never neglected to pay upon the regular day, which is every Friday, thus giving their workmen an opportunity to purchase their provisions in the public market, or in open competition on the streets, instead of trading in stores, at a sacrifice, as is customary with the workmen of large corporations who pay monthly or semi-monthly. In prosperous times more than 10,000 souls draw their support from these works. The Baldwin Locomotive Works are to Philadelphia what the iron interest is to the State of Pennsylvania. When the locomotive business is prosperous, nearly every other branch of business is progressing; when it is dull, most other trades and industries in the city feel the effects.

Now, Messrs. Editors, in the foregoing article I have only dealt with generalities, but as the great works are divided into many different departments, such as the draughting and designing, the modelling or pattern making, the founding, blacksmith, boiler, machine, finishing, erecting, repairing, quartermaster's supplies, shipping, etc., it would be necessary to take each up in its turn, when circumstances will permit, and discuss the extent, variety, and character of the work done in them, together with the characteristics of the superintendents, foremen, gang, or track bosses, in each department, and last, though not least, the proprietors of this great establishment.

No. 447 Broad Street,
PHILADELPHIA, *March 25th*, 1879.

New Automatic Cut-Off Engine.

A demand has existed for a very simple and accessible first-class automatic cut-off engine, one which can be sold as low as the



THE TWISS PATENT AUTOMATIC CUT-OFF ENGINE.—FRONT VIEW.

plain slide valve, or from one-third to one-half less than the prices usually obtained by the best engine builders.

The engine shown in the accompanying illustrations, made by Nelson W. Twiss, New Haven, Conn., is claimed to be the only engine yet produced in which these requirements have been fully met. The general design of the engine is of the well-known Corliss or girder type. The cylinder is jacketed with Russia iron, and rests upon legs bolted to the steam chest. The steam chest is located underneath and forms a part of the cylinder, serving as a reservoir for the accumulation of water, thus guarding against all danger of injury to the cylinder so common from that cause. There are four circular slide valves, two at each end and directly underneath the bore of the cylinder, thus securing the least possible amount of clearance.

Steam is admitted and exhausted by the main valves at each end of the cylinder. The cut-off valves are located inside of the main valves; these valves are driven by stems which pass through a hollow sleeve on the steam chest. The cut-off valve stems pass through the hollow stems of the main valves at the extremities of which cranks are keyed.

The main valve cranks are connected by a pitman, and receive a continuous oscillating motion by a single eccentric on the main shaft; the eccentric rod is made to disengage, at the pleasure of the engineer, on the larger sizes, by which means the engine can be worked either forward or backward with perfect ease, a point very desirable in practice. A spring is attached to the main valve crank and rests against the cut-off crank, the tendency of which is to keep the cut-off valve continuously closed, and in its closed position the cut-off valve crank moves by and with the main valve crank until it engages with a stationary stop which arrests its motion; the continued motion of the main valve crank opens the cut-off valve when a dog on the main valve crank passes over and engages with a shoulder on the cut-off valve crank. Should this connection of the dog continue throughout the stroke then the cut-off valve would be open continuously, but it will be readily seen that should the dog be tripped at any point during the stroke the spring would immediately act and close the cut-off valve. An air cushion is used to prevent jar in closing the valve. To automatically make the disengagement of the dog, a cam which loosens the hollow sleeve is placed in the path of an arm projecting downward from the dog, and whenever the arm strikes the cam the dog will be raised from its engagement with the cut-off valve crank, leaving it free to turn by the force of the spring and close the cut-off valve at that point. The tripping cams are connected with the governor which secures entire uniformity of speed under extreme variations of load. The speed of the engine may be increased or diminished while running by simply adding or removing weights from the governor.

Mr. Twiss also manufactures his well-known Vertical and Yacht Engines for whose excellency of design and workmanship he received the Centennial Medal and the Medal of Excellence at the American Institute, 1877.

For further information, address the patentee and manufacturer, as above noted.

Extracts from Chordal's Letters.

Messrs. Editors:

* * * I notice in your last two numbers illustrations of two most excellent milling machines, and I hope you will not stop at that. If there is any one shop tool to which we owe the national pre-eminence in manufacture, which we brag so much about, more than to any other, it is beyond doubt the milling machine.

The universality of this machine has been developed entirely in this country, and from that development has sprung manufacturing possibilities before undreamed of. Voluminous works on machine tools snub the milling machine entirely, and it is a notorious fact that not one word in regard to milling machines, or their cutters and manipulations, has ever been put in print as emanating from any one who knew anything about the subject whatever. If you can prevail on any of your New England readers to unfold themselves on this subject you will be doing the trade a service indeed. There is no machine whose virtues are so little understood outside of its New England home. It is usual for all large shops to have one milling machine, and if you ask any one arround the premises, from the owner down to the oiler, what that machine is, you will be told that it is a milling machine, and that it is used for fluting taps, and reamers, and such things. How little they know of the latent power of this machine to produce any sort of an effect on any metal, and to reproduce this effect with marvelous uniformity. As a jobbing machine, its virtue lies mostly in its universal adaptation, but in manufacturing it is found to be an unvarying power for good. It is nothing but a circular saw-mill when you come to look at it, but if there

is any one thing in the shop which don't get its deserts, it is the circular saw, or many-toothed cutter. You may file up a a nice shape for a special lathe tool, but you will find it dull in a short time, and grinding will invariably alter the shape. Not so with the milling tool. Its sixty teeth distribute the work between them, not all doing the same work, because we find human skill fails to make the teeth all bear alike, but some teeth will cut deeper than others and put the finishing touch on the job. A cutter with sixty teeth, cutting at the same velocity as a common tool, will generally outwear three hundred single tools. An attempt to cut gearing in a planer will generally let light in on the real merits of milling operations.

* * * New England is not only the home of the milling machine, but it is the national source of real happy ingenuity. There is a current belief that Yankee design runs to complexity and "trappery"—a belief not having the least foundation, in fact. When the New Englander takes it into his head to revise the work of mechanics from other sections, he starts new, discards every functional device, and produces the identical result with much simpler mechanism.

A marvelous gear cutter is brought to our notice, and, upon analyzing the machine, we must admire the perfection of every detail, the life-like action of its automatic devices, the absolute certainty of its operations, and the masterly manner in which the whole is constructed. But we look in vain for original detail, or novel devices. We find only an aggregation of well known elements and movements, skillfully combined, so as to produce a novel and original whole. We are impressed with the idea that this excellent machine is in reality a combination of many familiar machines which retain their personality, even in their novel position. Our New England mechanic designs the functions of this machine, but does not take the means. He designs a new one, discarding every element of the old one, and produces a machine which does not suggest anything we have ever seen before. His machine is *one* machine, and so perplexingly simple at that, that we wonder where the devices are. We hunt them up and find that each movement is effected by entirely original devices of extreme simplicity and perfect action. You remember, Messrs. Editors, that I showed you a few weeks ago, a machine in Sackett's office, a mechanical time keeper of men's work. This machine keeps the time of 200 men, shows when they went to work, and when they quit; and, by the way, if I can find time soon, I will send you a full description of this thing with illustrations. Well, this machine was gotten up by Quirk, who is one of those masterly designers who has all of the orthordox mechanical movements at his fingers' ends; he governs himself by the ethics of design, and deals only in pure mechanurgy. He wrestled with this machine many a long month, and succeeded famously.

When a workman bows before the machine it must record his name or number, the hour of his appearance, the day, the month, the year, and this it must do with accuracy.

Quirk got along all right till he came to the devices for dealing with the days in the month. Thirty days in one month, thirty-one in another, and twenty-eight in another, with a variation of a day every few years. He worried over the thing, piled detail on detail, and complicated movement on complicated movement, till the desired result was accomplished.

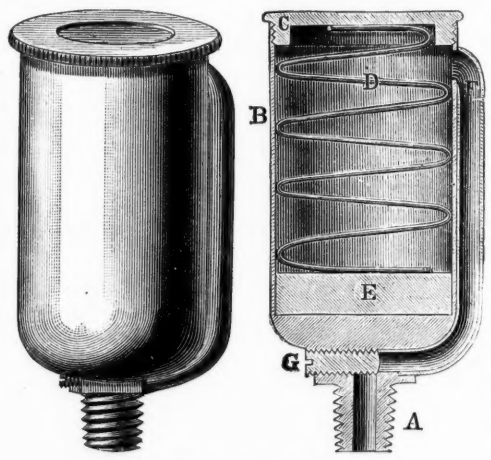
When completed the movement was a thing to stand before with awe and wonder, at the immense amount of skill and judgment which had been used up in its design, and the vast sums of money expended in its construction.

Quirk did this awe-and-wonder business for a time, and then it occurred to him that a common calender clock had to do just what this exasperating part of his machine had to do, and that it would be a good idea to look inside of one. He did so, and wished he hadn't. A single little insignificant piece of brass, not worth ten cents, did the whole thing. In meek humility, he bought a clock for ten dollars, and with it replaced hundreds of dollars worth of his tangled complex machinery.

Improved Thread Cutting and Diamond Point Lathe Tool.

* * * One peculiarity of New England design, or construction rather, is the apparent complexity which results from dividing things up into small pieces. Massachusetts planes up two surfaces and bolts pieces together, while Pennsylvania casts them together and produces a smoother exterior and greater appearance of general simplicity. I was once wandering through a machine exhibition and had struck up an acquaintance with a party from Fitchburg. We stopped to examine a lathe made by the Niles Works. The exhibitor told us the tube was cast upon the tail stock, while all New England manufacturers screw them on. When together the appearance is exactly the same, and there can be no difference in the value of the completed article. I have never been able to account for the Fitchburg parties' wonder, and his expression, "I don't see why they don't screw them on."

* * * We were admiring a Sellers' planer, and watching an Englishman who had evidently never seen one before. His mind evidently went back to the old screw planes and traced the thing down to the present, for he finally said, "I see, now; they used to make them all screw, now they make them all nut."



Loose Pulley Lubricator.

* * * I've got a sum in arithmetic for you. The case actually presented itself in Hunter's shop, and was the cause of much contention. Hunter's foundry accounts are kept by themselves; debit everything in the way of stock, sand, coal, labor, power, insurance, &c., which goes into the foundry, and credit it by the number of pounds of castings coming out. At the end of a year the book showed that the castings cost 3½ cents per pound. At that price the foundry made no money and lost none. In short, Hunter's casting cost 3½ cents. His foundry pays one cent for heavy scraps. He got a piece weighing 4,000 pounds into the machine shop, found it was wrong, and had to be broken up and a new one made in its place. Question: What was Hunter's loss on the blunder? Sacket, whose shop is just across the street, sells heavy castings at 2¾ cents. You will find knots in this thing.

* * * I have a legal question to put, and hope shop owners will feel called upon to express themselves, and cite some case in court which might settle the question. A man came to Hunter to have a machine built, asked Hunter what he would do it for. Hunter said he would not contract for the machine, and would only do it by the day. Five dollars per day for the work, and 4 cents a pound for all material. The man said he didn't object, but he wanted to know approximately what the thing would cost, so as to know whether he could ever pay for it or not. He only had so much money at his disposal. Hunter figured the thing up, and wrote that he thought it would come to somewhere in the neighborhood of one hundred and twenty dollars. The man said, "Go ahead on $5 per day and 4 cents per pound." When the machine was done Hunter sent in an itemized bill for seven hundred dollars. Man kicked, they quarreled and dickered over the thing, and finally came together in my place. They asked my advice. I told Hunter to sue the man for the amount of the bill, and I told the man to get somebody else to build a machine, and to sue Hunter for damages caused by delay. I am a peacemaker, you know, and try to straighten everything left to me.

But, honestly, what effect is a man's preliminary estimate and representation to have on his bill? This question comes up frequently, and there should be something known about the legal status of the matter. A customer frequently orders a thing on the supposition that his party can figure somewhere near the cost of the job. In the above case Hunter was a little "off," and the man would never have gone into the thing at any such figures, as the actual time brought out.

Another question: When Smith orders a job of Hunter, and Hunter charges Smith with the cost of the patterns, who is the owner of the patterns? It's a common question.

You get a photographer to make a negative of a machine, pay his expenses, and pay him ten dollars for making the negative, and he says the negative belongs to him. He will let you have prints at a certain price, but will not deliver the negative. There is no known way of getting a negative out of a photographer, except with a club. Bone had over a hundred negatives of woodworking machinery, or thought he had, but when he tried to change printers, the music began. If I remember rightly, the law failed to bring the negatives, and the matter had to be compromised.

Pope had a similar experience. He thought he owned fifty negatives of steam pumps, but the first thing he knew his artist had sold the things, and the purchaser was soliciting his orders for prints from them. If an artist would make no charge for negatives, I do not think the ownership would be a matter to question; but when the thing is ordered and paid for, and nothing said about prints, it seems to me they should belong to the man who pays for them.

* * * The Master Mechanics' Association meets in May, at Cincinnati. You'll miss it if you ain't there. This is one of the few societies which really gets together and does something. There ain't a dead man in it. It is not a square root or hyperbolic society, but is an association of hard-working hard-headed men, who get together and hold an experience meeting.

The reports of their meeting are worth gold to the practical man, for they contain no theory whatever, but simple, hard, solid experience of the solidest set of practical mechanics in this world. Master mechanics go to the meetings each year, to gather the experience of hundreds of men, while members of other societies seek only an opportunity to tell something. I never saw a man who had taken a degree, seeking information from another man. He always wishes to impart. The master mechanic keeps mum, and is always looking for the man who knows.

* * * * Very respectfully,

Chordal.

Improved Thread Cutting and Diamond Point Lathe-Tool.

The tool herewith illustrated is Beach's Patent Thread Cutting and Diamond Point Turning tool, manufactured by the Billings & Spencer Co., of Hartford, Conn. The holder is forged from mild bar steel, and the cutters from best tool steel. The cutters are clamped to the holders by a clamp with round stem passing through the holder, the side of the clamp being made beveling and provided with V shaped notches. The cutting tool is also provided with corresponding bevel, and V shaped notches on its back coming in contact with the clamp. Both cutting tool and clamp are let into the side of the tool holder, and when the clamp is drawn firmly up against the cutting tool, by means of the nut on the side, there is no possible chance of the cutting tool slipping in the tool holder It is as firm as if it was made solid from one piece of steel. The advantages of this tool over the old style now in general use are obvious at a glance to those versed in the art

The cutters are made true to U. S. Standard, their entire length, and in sharpening, it is only necessary to grind off the top One of these tools will do six times the work of the ordinary tool, and when used up can be replaced at about the cost of redressing the old style by the blacksmith. These tools are now made in two sizes. Two cutters are furnished to each holder for thread cutting and turning.

Small size is $\frac{15}{16} \times \frac{17}{32} \times 5\frac{5}{8}$ inches.
Large " $1\frac{1}{16} \times \frac{17}{32} \times 5\frac{7}{8}$ "

For further information, address the Billings & Spencer Co., Hartford, Conn.

Loose Pulley Lubricator.

The above cut represents a very efficient and reliable loose pulley oiler, recently placed before the public. Its action is positive and automatic.

The sectional view of the Lubricator shows the nozzle A, which is screwed into head of pulley; the reservoir B is filled with oil by unscrewing the head C, and contains the spring D and piston weight E. When the pulley revolves the weight E is pressed outward by centrifugal action, forcing the oil against the head C, and out through the feed pipe F and nozzle A upon the shaft. The faster the pulley runs the more oil is supplied to the bearings, unless cut off by the regulating screw G, whereby the supply of oil is controlled. When the pulley stops the spring forces back the weight E, which sucks the oil out of feed pipe into the reservoir, so that not one drop of oil is wasted. The saving of oil, belting, machinery, and time in oiling will be readily seen upon examination, also that it is entirely under the control of the regulating screw, which, when left open, entirely empties the reservoir in a few minutes, but when nearly closed it will make the oil last from one to three montsh, and do the work better than it would be possible for a man to do by oiling one or more times a day. When the pulley stops the flow of oil stops also, and when the pulley starts the oiler is always *ready* to do all that is required of it. There are various sizes for different dimensions of pulleys from 6 inch up.

These are manufactured by the Loose Pulley Lubricator Manufacturing Company, Middletown, Conn.

The Lowell machine shop, which has been running on two-thirds time with 480 men since November, has started on full time with 640 men, and the force is being constantly increased.

The Victor Sewing Machine Co., Middletown, Conn., are running with a force of seventy-five hands on sewing machines, Victor chucks and micrometer calipers.

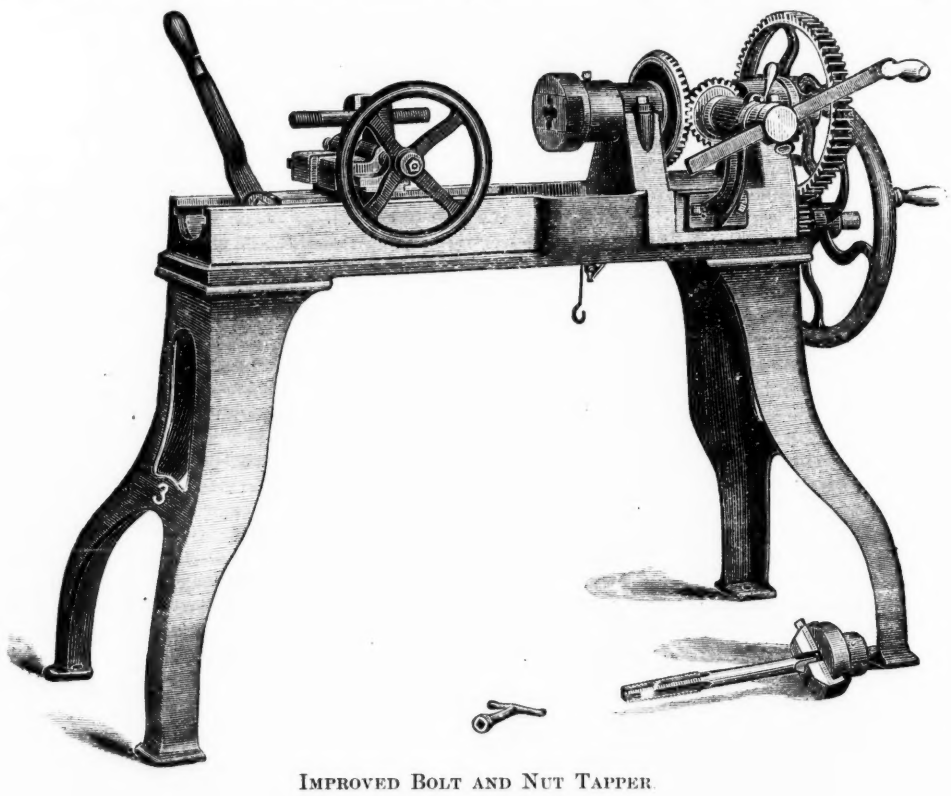
Improved Bolt Cutter and Nut Tapper.

The above cut represents a Bolt Cutter and Nut Tapping machine adapted for threading all sizes of bolts and nuts from ¼ inch to 1½ inches diameter With these machines large sized bolts can be cut with greater ease and facility, while small sized bolts can be cut as rapidly as with a small machine.

For cutting threads on large bolts, the machine is operated by the crank handle in the balance wheel. The side crank is used when greater speed and less power are required, as when cutting small bolts, or for backing out large bolts after they have been cut. Either of these crank devices may be quickly detached so that the other is adapted to be used separately, or if desired both may be used together. The vise jaws for holding the bolts are faced with fire hardened steel and are connected by a $\frac{15}{16}$ steel operating screw, while the top jaws are also of similar construction, thus rendering these parts very strong and durable and not liable to become quickly worn out by use.

All parts of these machines are substantially and thoroughly made, and all working parts carefully and accurately fitted

These machines are made both for power and hand. They are manufactured by E. N. Boynton, Worcester, Mass.



IMPROVED BOLT AND NUT TAPPER

EDISON OUTRIVALLED.

TALKING BY THUNDER AND LIGHTNING.

A NEW AUTOGRAPHIC TELEGRAPHIC SYSTEM, BY MEANS OF WHICH A MAN CAN TRANSMIT HIS OWN HAND-WRITING HUNDREDS OF MILES AWAY.

At the last meeting of the Electrical Society of the Ohio Valley, held at their rooms in this city, on the evening of March 19th, Mr. James W. See presented a detailed description, illustrated by photographs, of his new autographic telegraphing system, which he terms the Electro Pantograph. Mr. S. has had his European specification in London over two years, and as the public presentation of the subject before the above-named society, of which he is a member, was the direct result of an article appearing in our columns some days ago, to the effect that a similar system was soon to be made public in London, we have felt called upon to go over the papers read before the Electrical Society, and digest it for the benefit of our readers.

By means of this system one may walk into a telegraph office, pick up a lead pencil, stick its point through a hole in the end of a pointed rod attached to the instrument, and write his message, or letter, or check, or note of hand, in any language, short-hand or long-hand, good writing or bad, and as he does so a similar pencil at a station hundreds of miles away follows every movement, and this pencil coincidently produces a perfect duplicate of the author's writing. This affair opens up fine questions as to what constitutes a legal note of hand. There can be no doubt but what such a note is actually written by the maker. No intermediate process intervenes between the maker and the distant note, and the law does not say how long or how short a pencil must be, or whether it is to be made of wood and black-lead, or of wire and batteries, and retorts and electro-magnets and mechanism.

Mr. See's system is based on the theory, fully demonstrated in his paper, that lines, no matter how complex they may be, possess but two essential elements—direction and length; and that there are but four fundamental directions; and that all possible directions are formed by a combination of two of these fundamental directions. The fundamental directions are down, left, right, and up. The effect of a combination of two directions is fully defined by the well-known philosophical laws of resultant forces, the fundamental elements of all lines being the components.

The instrument consists of four keys closing four electric circuits. These keys are opened by the rotation of toothed pinions, and the pinions are rotated by toothed racks, having articulated rods attached. The pencil socket is at the puncture of these rods. A movement of the pencil in one direction will affect a series of breaks in one circuit and not affect the other three. The number of breaks is in proportion to the length of the line. If the pencil be moved in a curve it will result in a series of breaks in two circuits, and the relative number of breaks will depend on the relation between the two component directions of the curved line The receiving features of the instrument are similar to the portions just described, save that instead of rotating pinions breaking a circuit breaks in the circuit are caused to rotate the pinions. This is accomplished by means of four electro magnets whose armatures at each break in the circuit rotate the pinion as far as the pinion which broke the circuit rotated.

The instrument thus possesses vast executive powers. It analyzes the writing as it is produced, separates it into its component elements; transmits one of these elements over one circuit and another over another circuit at the same time; and as a receiver it receives separately the component elements of lines; properly combines them, and delivers them exactly as received. The author at the sending end places his pencil at the top of his sheet of paper; the weird pencil at the receiving station takes its position at a corresponding spot upon its sheet of paper; the author finishes a line and returns to commence a new one; the receiving pencil returns to commence its new line, and when the sender finishes and gives the final flourish to his signature, the obedient receiving pencil passively does the same, and waits for more influences from abroad. When the sender lifts his pencil from the paper and returns to cross a t or dot an i, the receiving pencil lifts, moves mysteriously through the air, crosses its t, &c., and goes on as the sender does.

This lifting of the pencil is effected by means which have not yet been described. The pencil at the receiving office, stands normally away from the paper, but is held down to the paper by an electro-magnet as long as a fifth circuit is closed. This fifth circuit is kept closed by the sender's pencil being down. If the sender lifts his pencil this circuit opens; the electro-magnet loses its force, and the receiving pencil lifts from the paper to return only when the sending pencil does.

But a single instrument is employed, it being both a sender and a receiver, and any number of them may be placed in a single line. The normal condition of the instrument is "out of action." The usual signals are employed upon any one of the circuits, and upon a station being called, a response given, the sheet placed in position, the pencils placed in unison, and the receiving lever turned, the pencil begins its magic journey. —*Cincinnati Enquirer*, March 23d.

Practical Hints on Leather Belting.

So much has been said and written on leather belting, much of it of a conflicting character, that those seeking information have often been deeply puzzled in deciding whose instructions to adopt. The following hints on belting are copied from a circular issued by Mr. Anton Heim, belting manufacturer, of this city, and may be relied upon as practical and safe to follow.

"SHAFTING, PULLEYS, &c.—All shafting should be made to run perfectly true at the first, for a slight negligence in this matter at the outset becomes constantly more serious the longer it is allowed to go uncorrected—causing loss of power and the rapid destruction of belts and machinery. The pulleys should be perfectly balanced and centered, and the circumference of both outer edges of the same pulley must be exactly alike, the highest part or crown of the pulley face being exactly in the center. The crown of the pulley face should not exceed one-eighth of an inch in height above that at the edges, to every twelve inches in width, and experience has demonstrated that these are about the best proportionate dimensions to secure the best running, and the greatest endurance of the belts. With the crown of the pulley face higher than this the belt is liable to be strained in the middle, and lifted off on its two edges, especially with light belts. Pulleys for shifting belts should not be higher in the middle, but have a straight face, and pulleys and belting alike should always be of ample size for the work to be done. It is extremely bad policy to have belting and pulleys only just large enough to do the ordinary work which is expected of them—for when they are made a little large than amply sufficient, they wear a very much longer time, and are certain to do the work with the minimum of friction.

"SINGLE BELTS may be used with economy as wide as twelve inches, but where greater width is required they should be of double thickness. All belts eight inches wide and more are cut out of the center of the hide, lengthwise of the back; this is necessary to insure their running straight. A wide belt, made of leather cut from the side, cannot, with the greatest care be made to run evenly, on account of the differences in the tensile strength of the different portions of the hide, as will be seen by reference to the diagram; but a wide belt, made from the centre of the back, has the same thickness and quality of leather on each side, and must necessarily run evenly, the lightest and weakest parts of the leather being in the middle, and the strongest and heaviest on the sides, the difference in thickness amounting in some cases to as much as one-fourth of an inch. For this reason, when a wide single belt is placed under a heavy strain, the thick heavy edge crowds up toward the center or lighter part running on the crown of the pulley, causing this portion of the belt to lift up from the pulley, and thus prevent that even, uniform hug, so essential where the best results are desired. Double belts are stiffer, and better able to resist this tendency to 'cup' in the middle and crowd up from the edges, as they generally hug the pulley closely along their whole width. There are those who hold that the single belt, being more flexible, adheres better to the pulley, but this is correct only in cases where they are subjected to but a moderate strain; where a wide single belt has to do heavy work it will be almost certain to stretch, lift up from the pulley in the middle, or the fastenings give way, whether they be of lace, hooks, or otherwise. Therefore, when a single belt must be used it should be of ample width for the labor to be performed, and run not very tight on the pulleys, so that the fastenings need not be strained. When the fastenings frequently give out it is a sure sign that too much work is being done by the belt, and either a wider single belt or a double belt should be substituted.

"For machinery which is run at a high rate of speed, and where fine work is done, light, even belts, with joints only cemented, should be used; such joints will pass over the pulleys smoothly, causing no jar or vibration to either pulley or shafting. In dry places, or where the belts are not exposed to moisture, common cement will be sufficient, but where the belts are exposed to dampness, a water-proof cement must be used. Leather belts thus cemented are far superior to rubber belts in every respect.

"DOUBLE BELTING.—Double belting should always be used where a slow motion, great strain and hard labor are required; also, when a belt is to be run at one-quarter twist, so as to give the proper angular motion the principal strain in these cases being on the sides. Belts which have to be constantly shifted, or those which are run on upright shafts, with flanged pulleys, should also be double. Where wide belts are made double they may be subjected to severe strain without injury, for there must always be one strong solid part of the leather to cover every point of possible weakness, or where the ends are lapped in breaking joints. For common work, in both single and double belting, cemented and riveted belts are good. It should not be forgotten in ordering belts, that one wide belt is better than two narrow ones, even if the two narrow belts would together cover more surface than one wide one. It is very poor engineering to drive a machine with two separate belts on one or two pairs of pulleys. When the pulleys are of exactly the same dimensions, which is seldom the case, the belts cannot be made so entirely even but what one will sometimes pull and the other slip, or one in some way be continually running faster than the other.

"BELT STUFFING, OR GREASE, should be applied to belts as soon as they show signs of electricity, and the belts must be carefully cleaned before the grease is applied; it must be used moderately, or the belts become soft and stretchy. Two parts of tallow and one part of tanner's oil, mixed with a little resin, making a good stuffing. An occasional application of castor oil is also useful.

"Putting belting on pulleys calls for special care. Both ends must be perfectly square before joining and where the belts are more than four inches wide, they should be put on with clamps as their straightness is often destroyed by 'running them on' instead of stretching over the pulleys with clamps,

"Belting should be run flesh side to pulley with the hair or grain side out, it being more

practical to run belts in that way. As the grain is more elastic than the flesh it can stand more bending but it being more tender than the flesh it will burn by the least slipping.

Prentiss Patent Vises.

The Hall Manufacturing Co., 23 Dey St., New York, have recently remodeled and greatly improved their Prentiss Patent Adjustable Vises, and under an arrangement for the manufacture of their goods by the old and well known firm of Bagley and Sewall, general machinists, of Watertown, N. Y., who have just completed a plant of special machinery for the manufacture of these vises, the Company are now prepared to supply the trade with an article of superior quality and

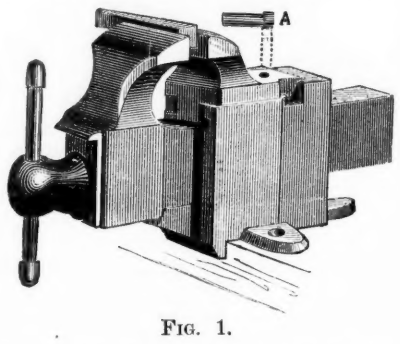


FIG. 1.

of first-class workmanship. The manifest merits of this vise, the simplicity of construction, ready adaptability to all vise work, and the general favor with which these implements are accepted, prompts us to give our readers the following illustrations and descriptions in detail of the same.

Figures 1 and 2 represent the adjustable jaw stationary and patent swivel bottom iron workers' vises.

The back jaw is adjustable and in use instantaneously conforms by automatic action to any angle, adjusts itself and makes firm the object held, whether it be straight, beveled or wedge-shaped. Or, if desired, by inserting the pin A (as seen in fig 1), the jaw becomes fixed and immovable, thus making a perfect parallel, or solid jaw vise.

The adjustable jaw, resting and working as it does upon and against the solid body of the vise, is thereby rendered absolutely as strong and durable as the old permanent jaw. By means of the new patent swivel bottom this vise may be readily adjusted to any

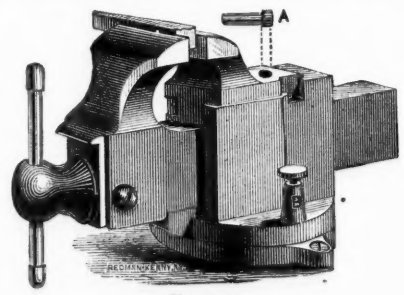


FIG. 2.

angle, right or left, at will of operator, by simply raising rachet pin B (as seen in fig. 2), which, on being freed, is instantly forced home by spring, rendering vise solid and firm as if stationary.

The mechanism of the patent swivel bottom is such as to render it fully as strong as the stationary or solid bottom, capable of carrying the heaviest class of work, and resisting successfully the shock of chipping, having been devised and constructed with particular reference to the class of work carried on in the largest establishments.

Figures 3 and 4 represent stationary and swivel bottom coach or wood workers' vises, constructed upon the same principles as the iron workers' vises above described. They

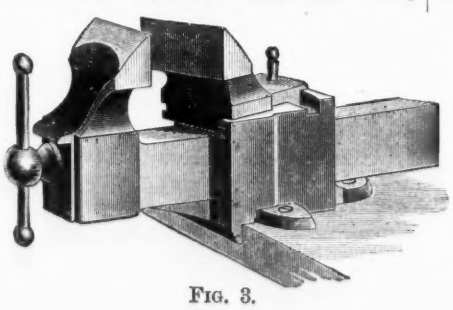


FIG. 3.

have been proved to possess many advantages over any other vise yet offered in this particular line of trade.

Figure 5 represents a sectional view of the parts showing in detail the simplicity of mechanism of the adjustable jaw and its supports, and from which may be seen there is nothing which can get out of order.

Figure 6 represents the "Challenge" (adjustable) pipe grip, patented 1879, and manufactured only for Prentiss Patent Vises.

This new implement adjusts itself to whatever angle the pipe held may require, thereby obviating loss of time in adjusting rest for long pipes, or in having them jam in the jaws. It also enables the operator to hold short pipes, couplings, thimbles, etc., in a vertical, slanting or horizontal position. The jaws are of best cast steel and therefore durable, and in construction it is so simple as to render getting out of order quite impossible. It is made in different sizes and is easily fixed to vise by set screws.

Figure 7 represents a superior clamp, made in malleable iron specially for temporarily fastening this vise to table, bench, or rail of vessels, the latter being a great convenience to engineers afloat, where shop facilities are necessarily very limited.

Editors American Machinist:

GENTLEMEN:—Do you ever have time to rest from your labors and meditate upon what a marvelous age this is in which we live, and what wondrous things it has accomplished? It has seen the prophecy of *Puck* fulfilled; it has witnessed the lightning borne away captive to do the bidding of man; it has taught us to count the pulses of the stars and measure the marches of the zodiac; it has rent the raiment of the sun, and taken an inventory of his wardrobe; it has burrowed through the bowels of the mountains, and filled their dim caverns with the echo of clanging steel; it has frightened the mermaids from their coral grottoes with flashes from the lantern of science, and it has seen the latest acquisition to your staff of correspondents, come gallantly to the rescue of an ex-mayor and Common Council from the attack of "Yours Truly." *Gloria in Excelsis*!

I wish to reply with a statement of facts from my point of view, and leave the matter with the jury to whom your correspondent has appealed.

I did not wander from my subject to attack anyone. I simply wanted an illustration, and in place of calling on my imagination for it, I took facts that are well established and with which I, among others, am conversant; and if your correspondent had not been so persistent in getting his "squib" in print, no one at the time unacquainted with "the facts" would have known to whom I referred.

"He knows nothing about me personally."

True, I do not know the gentleman from a side of sole leather, and have nothing to say about him as a man, and wish him all success in any business for which he is qualified; but as an incumbent of an office in which every citizen is interested, I claim the right to criticise his actions and also to reply to his "squib," which is before me.

To a proper understanding of this case, it is necessary to state that for several years previous to 1877, there had been no compulsory steam boiler inspection in Yonkers, and during that interval, some short-sighted citizens had purchased, and put in operation within the city limits, boilers of a dangerous description, some of which, I am informed, had been condemned, and a license to use refused by the sanitary police of New York city. With this state of facts before us, I commenced an effort to get a Steam Boiler Inspection Ordinance passed—and I have in my possession all the correspondence bearing on this subject to prove the part I took in it. After over a year of effort, an ordinance was passed of which sections 5, 6, 7, 8, 9 and 10 are as they left my pen, with the exception of the words "or otherwise" after the words "hydrostatic pressure" in section 5, and the words "except under such conditions and restrictions as the said inspector may prescribe in writing," at the close of section 6. These sections are all that I

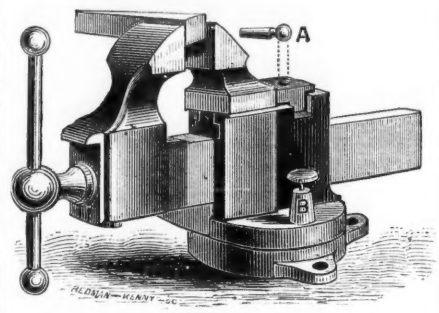


FIG. 4.

claim to father, and I will stick to them, and am ready to defend them at all times and under all circumstances. As soon as the rumor spread that the ordinance was to be passed, lo, a swarm of applicants for the position of inspector, started out with their petitions to get the signatures of the citizens, praying the Common Council, etc.

Result: The fellow that had the most names on his petition gets the appointment. So much for qualifications.

"The writer of that article was an applicant for the position I now hold."

True again, I had taken a lively interest in getting the ordinance passed; had been sent for and gone before the Board several times;

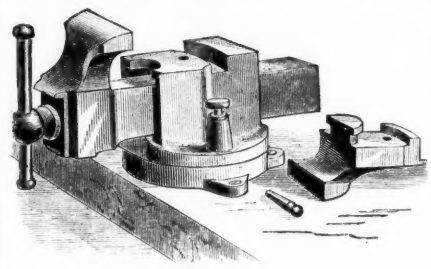


FIG. 5.

did not want to see boiler inspection made a farce of; was advised that the only way I could prevent it was to put in an application myself; and knowing that most people who are importuned to sign petitions for the appointment of candidates to office would equally as soon sign a petition to send the candidate to Sing Sing, I concluded, and did address a "six-line letter" to the Common Council, asking the appointment, and giving as my references Messrs. C. H. Delamater, Erastus W. Smith, and Henry R. Worthington, all of New York City. It is almost needless to add that I did not get the appointment. It is true that I was by the terms of the ordinance I had assisted in drawing up, disqualified from

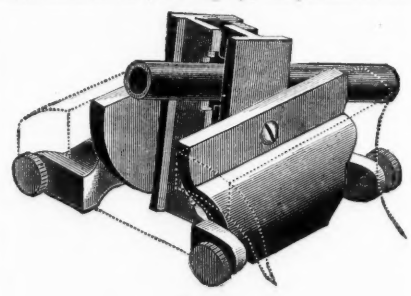


FIG. 6.

filling the office, and if I had been appointed would have been compelled to have resigned it. However, this is a fruitful theme, and I guess I will be excused if I fail *at this time* to give my reasons for thus daring to trifle with the dignity of that august body known to fame as the defunct Common Council of the City of Yonkers.

"Why did he make it imperative on the inspector to test by Hydrostatic pressure."

Knowing the conditions under which most political appointments are made, I tried to secure the only feature of which a farce could not be made, viz: *a graduated Hydrostatic pressure, that should in no case exceed the limit of elasticity of the metal of which the boiler was made.* Study that up and see what it means; it surely would not prevent a man from using his hammer also if he knew how.

"He would also have one man do all (!) the examining of engineers' and inspection of boilers."

Who was it that was afraid of this one man power?

The two competent mechanics that were appointed to assist in biting at this one little cherry are personal friends of mine, and manage to give some little dignity to the office, and their appointment meets my hearty approbation.

"And since my appointment I have uniformly made more use of my hammer than my pump."

Result. Boiler owners are getting so suspicious of method of inspection that they who can are rapidly availing themselves of the protection offered by the Hartford Boiler Inspection & Insurance Co., and they might do worse, by the way. *But of what earthly use is a hammer test if a man never goes inside of a boiler?*

"And I can point with pride to the fact that in the two years that I have filled (!) the office of inspector there has not been a single accident from steam in this city."

During the five years previous to the passage of this ordinance we had no compulsory inspection of steam boilers, and yet in all that time I have not heard of an accident from steam in this city.

"I am assured by a majority of those who supported me, that they did not and do not now know my politics." In Dec. article I said "for political considerations."

I said nothing about your correspondent's politics. There is a fable about a monkey who used a cat's paw to get chestnuts out of the fire. See?

As your correspondent has so extensively advertised Yonkers as the city, and himself as the inspector that I used to illustrate my Dec. article, I must say that if any of your readers feel interested in taking a tour through the engine rooms of this city they will find an abundance of evidence to justify even stronger language than I used in my Dec. article.

And now in conclusion I must say that while at all times ready to argue any question relating to the generation and application of steam, yet this is the first and last time that I will notice an article of the nature of your correspondent's, as I am convinced that mud throwing is no argument and is not conducive of any good result.

YONKERS, March 1879. W. H. ODELL.

Reviews.

We have received a complete miniature copy of the *Engineering and Mining Journal*, photo-engraved to one fourth the original size. It contains forty pages also ten finely illustrated supplements, comprising altogether a unique volume of the latest mining and engineering information not to be obtained from books on the library shelves Both print and engravings are perfectly legible, the work exhibiting a spirit of more than ordinary enterprise on the part of the publishers. The Scientific Publishing Co. 27 Park Place, N. Y.

Bullinger's Shippers and Travelers Guide for the United States and Canada for 1879 is a closely printed volume of 360 octavo pages, and contains in alphabetical order the names of every post office and railroad station and nearest railroad station, with plain shipping directions by express or freight line. It designates all money order post offices, telegraph offices, county seats, etc.—in short, exactly the information shippers and travelers want constantly at hand to refer to. It is compiled annually with the greatest care as to accuracy, and is furnished to all subscribers of the Counting-House Monitor (weekly) in New York City. Parties outside the city can have copies mailed them at $4 each. Several edition are published with particular information for different sections of the country. Address E. W. Bullinger, 75 Fulton St. N. Y.

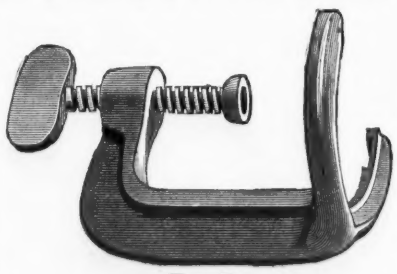


FIG. 7.

AMERICAN MACHINIST

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☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

NEW YORK, APRIL 15, 1879.

Frequency of Pay Days.

The question of paying workmen in shops and factories weekly, or monthly, has lately attracted a great deal of notice, some taking one view of it and others directly the opposite The *Springfield Republican*, which takes a strong stand in favor of weekly payments, learns upon careful inquiry that in New England monthly payments are the rule, rather than the exception. Our impression is, that it is the general custom to pay employees in the shops of New York, Pennsylvania, and adjacent states, once a week. That this is more satisfactory to the workmen can not be doubted. That it is more equitable than monthly payments, and more advantageous to collective business interests, can plainly be shown. The arguments presented in favor of monthly pay days are, first—the possession of additional means for credit by employers while the wages are held back; second—prevention of regular Saturday night sprees, and loss of time every week; and third—saving in clerical work. The first of these propositions assumes that manufacturers have a moral right to exact credit from their hands, or virtually, that they may require the men employed to furnish not only the labor, but a portion of the capital. Such ground is untenable. Whatever advantage the possession of money earned in wages may carry with it, for one or three weeks, belongs by right to the workmen, and not to the employers. There are, it is true, valid reasons why large corporations, with a wide-spread force of attachés like railroad companies, cannot conveniently pay oftener than once a month, but these reasons do not apply to a shop or factory. As for drunkenness, the periodical sprees indulged in by some laborers, doubtless had their origin in long interval payments. When a man has been for a considerable time without ready money and his wages for a month are received in a lump, he is inclined to feel plethoric of purse, and ready to celebrate his good fortune in a carousal, thinking that "a little cheer" on such a rare occasion will do him no harm. This makes his purse lighter as well as his head, and long before the day for pocketing his next wages rolls round, his means are exhausted. What then? The bondage of debt. The system of allowing constant mercantile credits is unduly extended and perpetuated by paying workmen at long intervals. The thrifty artisan, who, if he secured his wages weekly, would pay as he goes, ready cash, and make the most of his means, saving a fraction for a rainy day, entrusted with his earnings but once a month falls in arrears to the butcher, the baker, the grocer, and the clothier, thus giving them undue advantage in supplying him inferior goods at high prices, obtains his furniture on the "installment plan," paying therefor a good round percentage beyond what it would cost him cash down, and gradually gets so deep in debt that he remains there at the mercy of his creditors. The system of common credit extends from the laborer to the retail tradesman, from him to the wholesale dealer, and from the latter to every branch of business, giving serious annoyance to the progress of all legitimate industries. When wage laborers have ready money to supply their wants —which would follow steady employment and a general custom of paying every week —the wheels of trade run smoothly, and good enterprises are crowned with success; but with monthly payments the rule (and weekly the exception) even if laborers are steadily employed, business will often be troubled with spasms and the pathway for enterprise abound in pitfalls. Workers for wages form the largest part of the community and far the greater number of them depend on their current earnings for subsistence. The workmen keep the money they receive in circulation, and the more promptly it is paid to them the brisker does trade become.

The argument for paying but once a month on grounds of promoting sobriety is a very weak one. The proprietors of "gin mills" have a stronger hold upon workmen who tipple when they are paid at long intervals than if paid weekly, for these men soon run out of money and run up a score at some neighboring saloon which they feel bound to keep patronizing till pay day, lest its manager should become obstreperous for a speedy settlement of his account. It is a mistaken act of kindness to withhold the workman's pay for three weeks upon the excuse that he will not use it properly. As to this point the *Springfield Republican* aptly remarks: "This conclusion is on the old paternal principle that the laborer cannot safely be trusted with his hire. It is alleged to be a great kindness in the corporation to detain his wages even for a month, although when the fatal pay day comes it is followed by a debauch. If the pay were given oftener, would not the laborer become schooled to a keener sense of responsibility for his own welfare, and gradually learn more thrift? If it is wrong to trust him with a week's wages at a time, it must be four times worse to place in his hands a whole month's. There is only one system of labor which is entirely consistent with this theory of the superior intelligence and beneficence of employers, and that is slavery."

Theoretical *vs.* Practical Mechanical Instruction.

It is one great source of our national pride that to the youth are afforded ample means for obtaining an education of any character they may select. To those who desire professional knowledge, or a "liberal education," the doors of hundreds of well-conducted seminaries and colleges are open; to those who wish instruction in commercial affairs a multitude of schools for special business training present their advantages; while those who choose the vocation of mechanical engineers find a variety of "technical" institutions fitted to receive them, each offering to impart the best system of tuition in mechanics.

The plans upon which our technical institutions of learning are conducted are about as numerous as the institutions themselves, but, taking a general glance at the whole, we shall consider them as adhering to either of two distinctive methods of teaching—the theoretical, and the practical, of which the former are many and the latter few. There is, in fact, very little inclination among learned professors to drill the students in mechanical institutes in anything but book knowledge. They are plied with learned authorities during their whole course, and at the time of graduation can scarcely be convinced of the truth of anything in mechanics without being able to find it laid down by some author accepted as infallible in all his statements.

There are schools of mechanical engineering, as, for instance, the one belonging to Cornell University, and the Worcester Free Institute of Industrial Science, where the mechanic arts are taught as they are practiced in every-day business, and hands as well as heads are disciplined in the details of workshop manipulation, but these are notable exceptions to rule usually followed.

How many fresh graduates of polytechnic institutes are competent to run an engine-lathe on the ordinary work of a machine shop, keeping their cutting tools sharpened and in proper shape upon the common grindstone? In the graduating classes of most of them it would be hard to find a single one that could be trusted to do it without an overseer constantly at his elbow.

But, we are told, educated mechanical engineers need not perform the labor of a journeyman machinist. Very well; but how shall they be qualified to direct workmen at the lathe or bench if not practically familiar with the operations being performed? It would be hard to get a position as master machinist without giving tangible evidence of one's competency to perform the tasks assigned to the employees. The question is, what can a man do—not what does he know when the value of his services is to be estimated. If he can apply what he knows to solid practical advantage in the regular requirements of business, it is well that he be thoroughly versed in theoretical attainments. The cramming of students in mechanics with a bushel of theory to a pint of practice is an old-fashioned system that ought to give way to a more sensible and independent course, as demanded by the march of progress. Whether the student sets out to become an active shop superintendent, or aims to secure an office business, it is highly important that he should acquire a working experience in the use of tools and machinery. The curriculum of most technical schools bears no recognition of that fact. A great deal is taught that the students will never be called upon to use, the time spent in so doing being taken from the pursuit of other more valuable acquirements. Our high technical schools seem to be so far removed from the activities of everyday practical business, as to almost ignore what the graduates will be called upon to do when they are brought into lively competition with others in their chosen field of enterprise. When one of them, after passing a brilliant examination and pocketing his diploma, enters a machine shop and finds himself obliged to take position by the side of an unskilled apprentice, it may well be inquired whether a reform in the course of instruction is not demanded.

City Boiler Inspection.

That safeguards against the careless mangement of steam boilers should be provided by law in our large cities is demanded by a regard for the public welfare. That these laws should be strictly enforced is a prime necessity, else there is no justice in applying them at all. If a law is bad a strong enforcement will bring about its repeal; if it is good, the same course will prove a public benefit. For seventeen years a law has been on the statute books of the state of New York requiring annual inspection of all boilers used within the limits of this city, by a hydrostatic test to be applied by practical engineers under the direction of the Metropolitan Police Board. It provides that if any boilers shall be found unsafe or dangerous, the board shall cause them to be either repaired or altered so as to render them safe; else have them thrown out of use altogether. It is made a "misdemeanor" to apply a higher pressure of steam than that specified in the certificate of inspection. In case the owner of any boiler fails to report it for inspection, the board may take it under their control and prohibit all persons from using it until satisfactorily tested. When this occurs the owner must pay the expense of the test, otherwise there is no cost whatever for steam users to meet. The law also provides that, "no owner or agent of any steam boiler shall employ any person as engineer without their having a certificate as to qualification from practical engineers, to be countersigned by the Commissioners of Police." No charge is made to the engineer for his certificate. This law seems to be generally satisfactory to steam users in the city, but lately efforts have been made every year to enact a new law requiring owners of boilers and engineers to pay for their certificates, and creating a new Bureau to have the supervision of all boilers and engineers within the city limits. Two bills of this character are now before the Legislature; one introduced by Mr. Seebacher, and the other by Mr. Sharpe (by request). Both of them provide for establishing a bureau of steam engineering (or engineers), to be under control of an "inspector-in-chief," assisted by two examining engineers and a sufficient number of practical engineers to make inspections of boilers. Both also require all engineers to be licensed by the bureau, and to pay $3 each every year for that privilege. Severe penalties are named by both bills for failure to comply with their provisions. Mr. Sharpe's bill requires the payment of $5 for each annual inspection and certificate. If either of these bills should become a law (which is very unlikely) a coterie of high-salaried officials and well-fed political boiler inspectors will be in clover, and about three thousand engineers whose wages are meagre at best as well as every owner of a steam boiler in this city will be called upon for the means to sustain them in their dictatorial dignity.

One set of officials would be ousted to give place to another set vested with greater power, whose edict could at any time stop the running of a manufacturing establishment under pretense of insecurity of the boiler or insufficiency of its attachments. The bill introduced by Mr. Sharpe gives the Board of Examiners authority when, after inspection, they deem a boiler "or the appliances or apparatus connected therewith" insecure or dangerous, to "*prescribe such changes* or repairs as may render such boilers, apparatus, and appliances secure and safe." If, by any chance, this should become a law, we advise all manufacturers of patent gauge cocks, low water alarms, safety valves, alarm gauges, boiler scaling compounds, etc., to curry favor with these important officials as soon as appointed Quite a number of protests against the passage of these two bills from steam users and engineers throughout the city have been sent to Albany, and they will doubtless enlighten members of the Legislature as to the probable effect of enacting such a law.

Duty of Pumping Engines.

As we go to press the mail brings us a copy of the Eighth Quarterly Report of the Water Commissioners of Pawtucket, R. I., bearing date March 31, 1879. The following extract is peculiarly interesting to water-works officials, also to taxpayers in cities where pumping engines are to be purchased, as it exhibits a comparison of the best duties ever obtained in this country in practical trials. The duty obtained from the Corliss engine in three months' running is beyond any other performance of a pumping engine we have ever heard of:

THE PUMPING ENGINE.

A full description was given in the last quarterly report of the pumping engine built by the Corliss Steam Engine Company for the Pawtucket Water Works.

It will be remembered that the duty shown during the test of the engine was somewhat remarkable, viz., 133,522,060 foot pounds per 100 pounds of coal. This duty is believed to exceed any heretofore recorded in this country, the test of the

Worthington Engine,	Lowell,	being	69,000,438	in 1876
Nagle Engine,	Providence,	"	84,637,245	" 1875
Morris "	Lowell,	"	93,002,272	" 1873
WestSide, east Engine,	Chicago,	"	96,066,800	" 1877
" " west "	"	"	99,083,300	" 1877
Leavitt Engine,	Lynn,	"	103,923,215	" 1873
Corliss "	Pawtucket,	"	133,522,060	" 1878

The duty developed during the two weeks every day running was 104,357,654 foot pounds.

Since November. the reservoir has been in use and the engine has pumped only once a week, and only such quantities of water as were needed. The following table gives the number of hours run since January 1st; the amount of water pumped; the amount of coal consumed while pumping; the amount of wood used for kindling fires; the amount of coal used for heating the building on other days than those when pumping; the duty computed on all the coal and wood used during the three months, and the duty computed on all the coal and wood used while pumping. Wood is estimated at 45 per cent. of its weight of coal. The work of the week is generally done in one continuous run, without stopping. The building is heated with steam supplied from one of the boilers. A number of weir tests were made in January, at which the water pumped was wasted. The amount pumped is therefore not the amount actually consumed

Table showing work done by the pumping engine during the quarter ending March 31st:

No. of hours run.	Gallons of water pumped.	Coal used while pumping.	Wood used for kindling fires.	Coal used when not pumping.	Duty on all coal and wood used during the quarter.	Duty on the coal and wood used while pumping.
496	62,226,567	108,382	2741	28,374	95,180,000	121,181,111

From these facts it appears that the engine continues to maintain its high reputation for the economical consumption of fuel.

In the advertisement of the Gardner Governor manufactured by Robert W. Gardner, Quincy, Ill. in our last issue, the dropping of a cipher made it appear that only 1100 of these governors are in use, whereas the real number in use (written in the copy) is 11000 (*eleven thousand*). The Gardner Governor may be found almost everywhere in the United States where steam power is used, and to some extent in foreign countries.

Correspondence.

To the Editors of American Machinist:

In reading the various articles and statements as they appear in the mechanical publications and text books, I have frequently noticed that different authors attach different definitions and meanings to the same term. Now it seems as though there ought to be some well-established meaning for the various terms in use by the engineering profession, or else an author ought to clearly define his terms before he uses them, and so prevent any misunderstanding as to their import. The word "friction" seems to me to be one of those terms that is not as clearly defined as it should be. Different engineers using the term "friction" couple it with another to qualify or designate the particular kind of friction to which they refer. Such as "rolling friction," "sliding friction," "dynamic friction," "static friction," "fluid friction," &c.

To quote from Morin, "The *resistance occasioned by friction* is independent of the velocity of motion and extent of surface." Here the resistance is caused by "friction;" while Prof. R. H. Thurston in an article on "Lubrication" in the *Polytechnic Review*, March 3, 1877, says: "When two surfaces are rubbed together, however smooth they may be, a *resistance is met with which is called* 'friction' (from the Latin *frico*, to rub). When a current of fluid moves in contact with the surface of a solid, or with a mass of other fluid, a resistance is also produced. In the former case this resistance is due to the interlocking of minute asperities of surface and their forcible removal. In the second case the resistance is due to the production of little eddies and currents within the mass of fluid. It is seldom due to real rubbing of fluid against solid."

And the professor also states "that in some cases 'friction rolls' or wheels, are substituted for rubbing surfaces, and the resistance is then 'rolling friction,' *which is not properly friction at all.*"

In *The Railroad Gazette*, Feb. 21, 1879, I find an editorial headed, "Mr. Westinghouse's latest improvement of continuous brakes," containing some extracts from London *Engineering*. In this, allusion is made to the fact that it takes more power to slip the driving wheels of a locomotive at the start than it does afterward; and the reason given for this is, that so long as a wheel rolls on the rail, the surfaces are in a state of "static friction," whereas when they begin to slip the surfaces are subjected to "sliding or dynamic friction;" and a few lines further on, *adhesion* is spoken of as, "a kind of friction."

These quotations will serve to show the different ways in which "friction" is used, and it seems as though there ought to be a clearer definition of the term. If adhesion is the force tending to cause the particles of one mass to stick or adhere to those of another (which I believe is the common definition), then this being "a kind of friction," does it not seem to conflict with Prof. Thurston's definition? If the wheels of a locomotive adhere to the rails, is there any friction until the wheels begin to slip? Leaving out the resistance of the journal bearings; or, supposing a pair of wheels to be placed on the rails without any thing resting on them, then, in rolling them over the rail, the only forces to be overcome, so far as I can conceive, would be "the adhesion" between the wheel and rail, due to gravitation—the former being overcome by separation of the surfaces, and the other, raising or elevating of wheel, and its prominences of surface over those of the rail. While there is some friction among the particles composing these prominences, or asperities of surface, owing to their being crushed and broken in the course of the wheels rotation, there is no real "sliding friction" in the latter case, assuming that the wheels do not slip. If the rolling of a wheel is "not friction at all," as stated by Prof. Thurston, then true friction is "sliding friction," and the only term that should be used. Can there be any other?

Sam. Webber,
No. 15 Gold St., N. Y.

Syracuse, March 29, 1879.

Editors American Machinist,

Dear Sirs:—In the January number of your valuable paper I saw an article on the "Construction of Domes for Steam Boilers," from which I gained much, to me very valuable, information. Since then, I have been thinking I would write and ask you to add the word Engineer to the title of your sheet, and thus invite the attention of the large and intelligent class of young men in our country, who are proud to call themselves by the latter name; and I can assure you, Sir, many of them are worthy of it. The roll of "Starters and Stoppers," as our friend calls them, is growing less every year. Steam users are finding that the average cost of running an engine cannot be reduced by hiring a cheap man, as the increase in coal bills hardly needs to be added to the "sundries" and repairs to make the full yearly expenditure for wages of a competent man.

I would like to submit to your own, and the judgment of your readers, if you see fit, the following—concerning the object of the dome, and also to exchange opinions as to the best proportions in order to secure that object first. I suppose all will agree with me that the object of adding a dome to the steam boiler was to aid in securing dry steam. If we grant this; and further, that the steam is generated by the fire under or in the boiler, as the case may be, and is perfect, and in the best possible condition to do its work the moment it is formed and is free from the water, then it would naturally follow that the sooner it is used the better, as it certainly gets no hotter, or gains any thing in its elasticity or expensive qualities, which are all that render it of any value. Then it would naturally follow that the dome should be so constructed as to facilitate the escape of the steam from the water, and make the separation complete and final at the earliest moment possible; by giving an increased area for the current which must flow from the boiler through the steam pipe, while the engine is in motion, would help to secure this result. I see no reason to give more room in the dome than is sufficient to prevent any variation of pressure in the boiler, as the cylinder of the engine is filled with steam. Thus my experience has been that a dome with a capacity equal to that of the cylinder of the engine is large enough, if rightly proportioned. As the value of the dome depends not on its height, but on the large area of the base, and consequent widening of the opening, which the whole product of the boiler must pass through as it does its work, thus preventing its forming a strong current and raising water or foam during its passage. Your correspondent rightly condemns the practice of setting the dome on the shell and only cutting one hole for the steam to pass through. I have seen such a one where the hole was only equal to the size of the steam pipe. He did not go far enough though, for beside making men swear at torn clothes or loss of time, the practice is the same as leaving off the dome, only worse, for if the steam pipe had been tapped into the shell of the boiler there would have been several square feet of condensing surface saved. Give me a dome equal to the capacity of the cylinder, and with a diameter equal to its height, a dome of these proportions, and with the shell cut away under it, and I believe there would be very little cracking in the cylinder or any of the other disagreeable and more than annoying accidents caused by priming in boilers.

"G."

One of our correspondents sends us the following rule to find the proper size drill, for drilling to *tap* a *full standard* V thread:

Multiply the number of threads to inch on tap by 2 to form the denominator of a fraction, for which take 3 for the numerator, subtract this fraction from the outside diameter of tap, the remainder is the correct diameter of hole.

Example: Required to drill for a 1 in, 8 thread tap:

$8 \times 2 = 16$, $\frac{3}{16}$, 1 inch $= \frac{16}{16} - \frac{3}{16} = \frac{13}{16}$, answer.

Yours, S.

A Card.

Editors Machinist:—

In your March issue appears a criticism, by Mr. Stephen Roper, upon the articles on "Engineering Popularized," by Mr. Wm. Lee Church, in which our names, among others, are mentioned as engineers of far superior ability to the writer under review. As we happen to enjoy a pretty thorough acquaintance with Mr. C, as a man and engineer, we deem it our duty to state that the facts do not warrant a reference to us, or either of us, as his superiors in ability of any kind.

He is, probably, one of the most successful practical engineers in the country, and your readers will do well to give his articles careful attention.

It will be noticed, however, that Mr R. confines his criticisms almost entirely to Mr. C.'s use of figurative expressions (which we presume no one but Mr. R. ever thought of interpreting literally), and makes no attempt to discuss the subject on its merits with the candor and scientific ability that we have a right to expect from so eminent an authority. In fact, he (inadvertently, no doubt,) neglects to give your readers any clear evidence of his ability to do so.

Joel Sharp.
J. W. Thompson.

Business Specials.

Thirty cents a line for each insertion under this head.

Brown & Sharpe M'f'g Co., Providence, R. I., keep in stock at reduced prices Patent Cutters for the teeth of gears which can be sharpened by grinding without changing their form. All wheels of same pitch cut with them will run together correctly. Send for new catologue

The Pratt & Whitney Co., of Hartford, Conn., make a specialty of Cutters for the teeth of gear wheels, that are shaped entirely by machinery and will make interchangeable all gears that are cut with cutters of the same pitch.

For Drop-Forging, Packer Ratchet Drills, Lathe Dogs, Screw Plates and Dies, address The Billings & Spencer Co., Hartford, Conn.

National Steam Pump, simple, reliable and durable. Send for illustrated catalogue with reduced price list. W. E. Kelly, New Brunswick, N. J.

Swedish iron, undisputably the best in the world, is to be found with *Charles G. Lundell*, of No. 7 Exchange Place, *Boston, Mass.*, at *lowest* market prices and of brands well know in this. Being direct agent for the largest shipping commission house of his native country, Sweden, his facilities for offering iron for importion as well as for sales from warehouses in New York, Philadelphia, and Boston cannot be surpassed.

For Screw Cutting Engine Lathes of 14, 15, 18, and 22in. Swing. Addr ss Star Tool Co., Providence, R. I.

New Screw Cutting Engine Lathes, extra quality, at low prices. 16 in. x 5 ft., *complete*, $225.00. 18 in. x 6 ft $275.00. 24 in. x 10 ft., Hollow Spindle, 2¼ in. hole, $425.00. York & Smith, Cleveland, O., Manufacturers Nut, Bolt and Washer Machinery, and dealer in Machinist's Tools.

W. H. Warren, Designer and Manufacturer of Special Machinery. Works, 25 Hermon Street, Worcester, Mass.

Questions and Answers,

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) H. B. S., St. Paul, Minn., writes: Please give me some simple method of testing the quality of iron? A. If fracture gives long silky fibers of leaden gray hue, fibers cohering and twisting together before breaking may be considered a tough, soft iron. A medium even grain mixed with fibers, a good sign. A short blackish fiber indicates badly refined iron. A very fine grain denotes a hard steely iron apt to be cold-short, hard to work with a file. Coarse grain, with brilliant crystallized fracture, yellow or brown spots, denotes a brittle iron, cold-short working easily when heated, welds easily. Cracks on the edge of bars sign of hot-short iron. Good iron is readily heated, soft under the hammer, and throws out but few sparks. Iron while heating if exposed to the air will oxidize; when at white heat, if in contact with coal, will carbonize or become steely; should be heated as rapidly as possible.

(2) Wm. B., Garrett, Ind., writes: Can you tell me how the art of lithography is done? A. Lithography.—The process of engraving on stone in such a way as to produce a surface from which printed copies can be multiplied in a press. The stone is brought from the Solenhofen quarries in Bavaria. Upon the surface of the stone the artist draws the design to be printed from in one of four following distinct ways, viz: 1st. He draws it with lithographic ink. 2d. With a solid crayon. 3d. He obtains it by transfer from an inky design on paper (produced by various means). 4th. He engraves it on a prepared stone. The first is the plan in general use. The surface of the stone is polished and the design drawn upon it with ink and left to dry upon the stone. It is now subjected to an etching process, the object is to act upon it chemically. The application of a weak acid (nitric or hydrochloric) over the whole surface does not destroy the design or wash it away, but forms a chemical combination with the ink and eats into the stone. The whole surface is flooded with gum arabic and water, after awhile the excess of gum is washed away. The stone is placed in the press, and the excess of gum carefully removed from the drawing so that it is perfectly clean (by the use of turpentine). The printer now applies the ink roller over the surface until the design is filled with ink when the paper is applied and the printing process begins.

(3) C. M. S., Indianapolis, Ind., writes: What is the propelling power of compressed air as compared with steam; and where could I find a work on air pumps, or any work on compressed air motive power? A. See "Power by Compressed Air," by Robt. Zahner, published by D. Van Nostrand, 25 Murray St., N. Y., at 50 cents.

(4) W. R., Keokuk, Iowa, wants to know whether water in a boiler gets any hotter after it begins to boil? A. No; if the steam be allowed to escape; because water cannot be heated above the boiling point; all the heat absorbed by water after it boils is employed in generating steam. As soon as the temperature reaches 212 degrees, steam is formed and carries off some of its heat; therefore 212 degrees of heat cannot be transmitted through it. To illustrate this fact, place a tin pail of cold water within a kettle of boiling water and attempt to boil it. This experiment will convince the most skeptical.

(5) W. L. N., Pittsburgh, writes: Can you tell me how an Injector works, and describe the principle, as I often hear the question asked and never answered in a plain manner? A. Steam escaping from under pressure has a much higher velocity than water would have under the same pressure and condition. The escaping steam from the receiving tube unites with the feed water in the combining tube and gives to this water a velocity greater than it would have if escaping directly from the water space in the boiler. The power of this water to enter the boiler comes from its weight moving at the velocity acquired from the steam, and it is thus enabled to overcome the boiler pressure. Now, as already stated, the steam, under a given pressure, escapes from an orifice with a very much greater velocity than water. But steam being very light, if its weight is multiplied by its velocity its total energy will be comparatively small. Now, in the injector, a portion of the high velocity of steam is imparted to the heavy water, because this water is presented to the action of the steam, not in a mass as in

the boiler, but in small quantity and in such a position that it can easily escape, so that it gradually acquires as high a velocity as the escaping steam can impart and at the same time the steam is condensed, therefore there is a heavy substance with a high velocity, whose actual energy is sufficient to overcome the pressure in the boiler. If the steam were not condensed we would have a comparatively light substance moving at a high velocity which, as already explained, would have little actual energy, and would, therefore, not overcome the boiler pressure. An injector will not work when the feed water is too hot to condense the steam, therefore the colder the water the better the injector will work.

(6) S. E. W., San Francisco, writes: I noticed in your Dec., 1878 issue an article entitled "Boring Cylinders," by L. F. Lyne, wherein he states that he is aware of the existence of a machine that will bore and finish the ends in three-and-one-half hours. This statement is generally doubted. Please let me know if there is any tangible evidence to corroborate this statement? A. The remarkable time made in boring cylinders was at the tool works of Wm. Sellers & Co., Philadelphia, and was done as a test to ascertain the capacity of the machine. They have the data with full description, and doubtless would send it to you by writing to them.

(7) Ignis, Chicago, writes: 1. Can you tell me the most economical size for Locomotive Boiler Tubes? A. It has been found, after long practice and repeated experiments, that tubes of 2 in. diameter give the best results. By varying either way, difficulties will present themselves which do not appear in using 2 in. tubes.

2. What is the best form for a Locomotive Boiler, also, the most economical? A. We recommend a boiler with 8 in. to 9 in. wagon top; that is, the outside shell of the boiler over the fire box is elevated above the cylinder part from 8 in to 9 in. which gives more steam room. It is not a good plan to go to extremes in this matter, as the greater the elevation the weaker the boiler. There are more explosions of straight boilers than any other, owing to the small water space over the crown sheet and tubes.

(8) S. & Co., Chicago, Ill., writes: We find it very difficult to get two grindstones of the same quality, which is a source of great damage and inconvenience to us. How can we obviate this difficulty? A. When you get a stone that suits your purpose preserve samples of it, and when ordering send a sample to your dealer to select by. A half ounce is sufficient and can be sent by mail.

(9) P. K., Cleveland, O., writes: We have a cushioned hammer which is a source of much trouble caused by the breaking of the bolts which hold the top die and casting to the wooden beam. What is the best course to pursue? The bolts are 1¼ inches in diameter. A. Drill a hole ¾ inch in diameter clear through the bolt, lengthwise, which will add greatly to the strength.

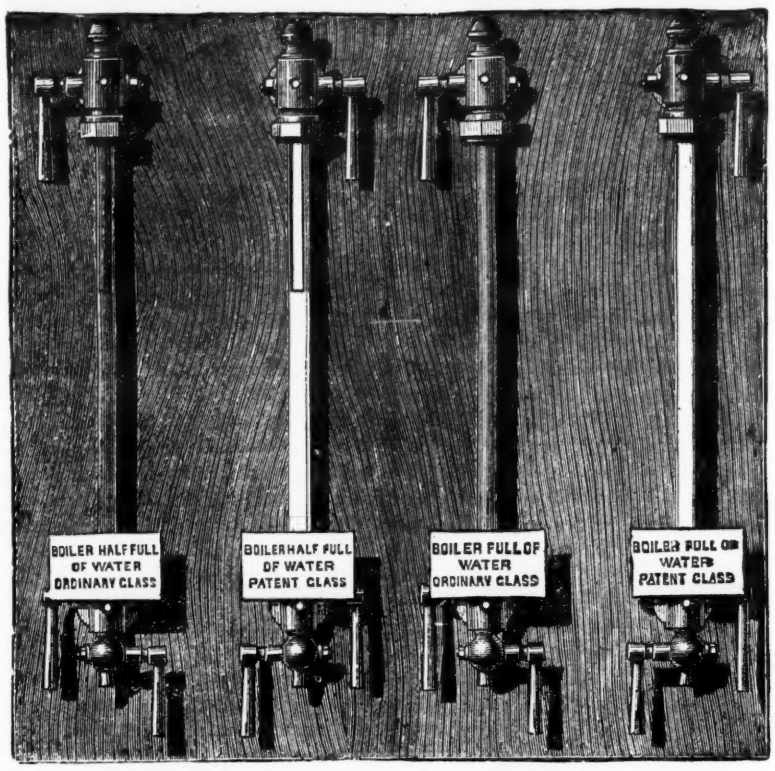
(10) A. B., Lynn, Mass., asks: Is there any rule for the size and velocity of belts to find the horse power they will transmit? A. The horse power of a belt equals its velocity in feet per minute multiplied by the width and the product divided by 1,000. One inch single belt moving at 1,000 feet per minute=1 H. P. Double belts about 700 feet per minute per inch wide=1 H. P. For double belts of great length over large pulleys allow 500 feet per minute per inch of width per H. P.

(11) E. E. W., Carlisle, Pa., asks: Is there any way of hardening metal castings in certain places without hardening the whole piece. Please answer in your March number if possible? A. To harden cast iron: heat the casting to a cherry red and immerse the part to be hardened in the following solution: In three gallons of clean rain water mix one-half pint oil of vitrol and two oz. saltpetre. For Malleable (cast) mix equal parts of common potash, saltpetre and sulphate of zinc, and use same as prussiate of potash by sprinkling on the casting while it is a cherry red, then cool off in the above solution.

(12) "Reader," Bridgeport, Conn., asks: Is there any process for tinning cast iron by dipping if properly cleaned by acid? A. The articles to be tinned are first covered with dilute sulphuric acid, and when quite clean are placed in warm water, then dipped in a solution of muriatic acid, copper and zinc, and then plunged into a tin bath, to which a small quantity of zinc has been added. When the tinning is finished the articles are taken out and plunged into boiling water. The operation is completed by placing them in a very warm sand bath. This last process softens the iron. Under ordinary circumstances the following will answer: Take any quantity of muriatic acid and put in all the zinc that it will dissolve, dilute with one-fourth as much soft water as of acid, add a little sal-ammoniac and rub it on the iron. If the first application is not successful make the second application.

(13) L. R., Baltimore, Md., writes: Please let me know which steel will harden the hardest, and how to do it—that is, in what composition or fluid? A. Any good cast steel can be hardened to a high degree by tempering with "Steeline." There is a kind of steel used in England for lathe tools which is so hard naturally that it requires no tempering, and great care is necessary in forging the tool. If it is dipped in water it will break like glass. It is used to some extent in this country but is generally condemned because the tool makers do not understand it.

During the month of March, 49,000 loaded cars were hauled over the main line of the Central Railroad of New Jersey, which was the heaviest month's business the company ever did.


BOILER HALF FULL OF WATER ORDINARY CLASS
BOILER HALF FULL OF WATER PATENT CLASS
BOILER FULL OF WATER ORDINARY CLASS
BOILER FULL OF WATER PATENT CLASS

Enameled Water Gauge Glasses.

It is a matter of the highest importance to an engineer to always know the height of water in his boiler. If the water gauge does not plainly show this mistakes and accidents are likely to occur. On this page is shown a comparison of the common glass gauges and the patent enameled water gauge glasses for which the Ashcroft Manufacturing Co, 55 Sudbury street, Boston, are sole agents for the United States. With these the water in the tubes is reflected from a white enameled strip in the glass, showing the water white as milk. Thus the height of water can always be seen at a great distance and in dark situations. It can also be seen at a glance whether the water is above the top or down below the bottom gauge. With ordinary glasses it is very difficult to ascertain whether the boiler is full of water or empty. The enameled tubes run evenly in lengths and diameters, and are very popular wherever used.

MANUFACTURES.

I. B. Davis, Hartford, recently sent a Berryman Feed Water Heater and Purifier, 21 feet long and 5 feet diameter, weighing four tons, to Lewis, Oliver & Phillips, Pittsburgh, Pa.

The Hartford Machine Screw Co. are driven to their full capacity with 100 automatic machines in regular operation. They are having thirty more screw machines built by the Pratt & Whitney Co.

A. F. Cushman, Hartford, has just brought out a new centering chuck, with capacity to three inches, also a small size centering chuck of new design.

The Pratt & Whitney Co. have recently sold $7,000 worth of special machinery to the British Government. The order was received in competition with several English concerns.

Hill, Clarke & Co. have about 4,000 square feet of floor room in their new machinery warerooms, 36 and 38 Oliver Street, Boston, making it one of the best arranged and commodious machinery depots in the country. They keep in stock the best selections of machinery and tools, steam engines and boilers, and have a very entensive trade.

The Sherrill Roper Air Engine Co., 91 Washington Street, New York, have recently put in a number of additional machines, and have leased the premises next door to the shop, heretofore occupied as an extension. Their orders for hot air engines show a gratifying increase.

F. B. Norton, Worcester, just sold a lot of 500 Emery wheels to a party in Illinois for knife-grinding machines. He has had a large increase of orders for emery and corundum wheels within the last three months.

The Stiles & Parker Press Co., Middletown, Conn., will soon move into their new shop, built especially to meet the demands of their growing business.

Geo. P. Clark, Windsor Locks, Conn., has established an excellent trade for his patent rubber casters and truck wheels, and is pushed with orders. They are growing in favor, especially commended as they are noiseless in action.

Chas. Ervien & Co., Philadelphia, are building an improved detached 10 x 12 hoisting engine for shipment to California to fill an order.

The Lathe & Morse Tool Co., Worcester, have had a larger amount of order for machine tools thus far this year than for the same time any other year since the panic.

The Worcester Machine Screw Co. are running full capacity with a gratifying increase of orders.

The Billings & Spencer Co., Hartford, are pressed with orders for Billings' Adjustable Pocket Wrench, although but a short time since it was introduced.

The Brown & Sharpe M'f'g Co., Providence, will soon offer some new machines with important improvements.

The R. I. Locomotive Works, Providence, have an unusual amount of work on hand and are employing a large force.

The Holyoke machine company have received letters from English manufacturers requesting additional copies of Emerson's treatise on water wheels, and with flattering inquiries regarding the Hercules wheel.

W. H. Warren, Worcester, designer and manufacturer of special machinery, has just enlarged his shop and increased his working force. In one day recently he received orders to build eleven special machines.

C. Whitcomb & Co., Worcester, have recently perfected a new style or iron planer.

Rice & Whitcomb, Worcester, have lately experienced a large increase of orders for their punching and stamping presses.

In a recent visit to the shops of the Singer Manufacturing Company, Elizabethport, we noticed many things of interest which we may hereafter refer to. They are employing a force of 1,800 hands and are using 30 tons of pig iron a day in the manufacture of sewing machines.

An Engineers' Movement.

A meeting of engineers was held in this city on Saturday evening, the 12th instant, to discuss legislative methods to protect the trade from a large class of incompetent and careless individuals who are hired by many steam users to run boilers and engines. It was stated that 28 boilers in this city are *in charge of women* who are janitors of the public schools, and that hundreds of boilers (many of them located under sidewalks) are run by cheap, ignorant and irresponsible men. Many steam users employ the cheapest (and therefore poorest) men they can obtain to manage their boilers, thus jeopardizing the lives of all whose business calls them near these steam generators when in use.

There is a law framed for this city and now in force, requiring every engineer to be fully examined by competent men, and provided with a certificate before he can take charge of a boiler. This law, it was said, is honored more in the breach than in the observance, many working without any license, and others given one for political reasons. Competent and careful engineers, who are thoroughly skilled in their business, are daily crowded out of their situations by green hands, whose knowledge of a boiler goes but little, if any, further then how to keep fire under it, and who offer their services at $6 to $10 a week. Few out of a great number of boiler owners can judge of the qualifications of an engineer, and *no one* should be *allowed* to act in that capacity without sufficient qualifications. It was agreed if the present law were fully carried out in practice the evil complained of would be abated, but of the two bills lately before the State Legislature (and reported adversely) to change the law, the meeting could not agree which would have proved the better to adopt. We heartily concur with the engineers, not only in New York, but in all other large cities where this trouble exists, that some kind of redress, by properly constituted authority for the grievances complained of, should be demanded and secured. If mass meetings of engineers, both those *outside* as well as *inside*, their trade societies could be convened, and their united wishes plainly indicated, we believe a beneficial result would follow.

Editors American Machinist:

In the February issue of the MACHINIST, our friend Chordal has one of his really good and readable articles. Now we all (at least all whom I have heard speak of them) enjoy reading "Chordal's Letters," and have found not a few things in them that we can all profit by; but I, for one, cannot agree with him on one point, and, in fact, if he will take a second look at it himself, I think he will retract his statement in regard to the purchasing, or rather not purchasing, of a planer, because a man has not money enough to buy such a one as suits him. There are a good many small and inexpensive planers and shapers made that will do well and profitably any piece of work that can be placed into them. Would friend Chordal like to fit up connecting rods for engines, and a thousand-and-one other pieces of a similar class, direct from the forging, without planing? I am afraid not.

Perhaps friend Chordal has never had the *pleasure* of standing at a vise, chipping and filing all day on a piece of work that he knew could have been done in less than half the time, and much better, on even a small and poorly made planer.

I do not advocate the purchase of tools too small for the work they are intended to do; but I will say that if I had a machine shop without a planer, I would take the little money that he advises me to lay by and get what I could in the shape of such a tool, and with this addition, and the saving in files, sooner be able to buy me a good and suitable planer than friend Chordal could do, relying upon his hammer and chisel. This is not theory, but as the boys say, "I've been thar," and know whereof I speak.

JOHN J. GRANT.

Machinists' and Engineers' Supplies.

The market remains without any stirring features. Trade continues fair, with very little change in prices. A. F. Cushman, Hartford, has just brought out a new centering chuck, with capacity up to three inches, which will be sold at $9 or $10, also a small centering chuck to sell at about $6. Descriptions of them will appear in our next.

The following circular has been issued:

HARTFORD, March 27, 1879.

To the Public—This is to certify that we have given to the Billings & Spencer Co. of Hartford, Conn., the exclusive manufacture and sale of E. B. Beach's Patent Thread Cutting and Diamond Point Lathe Tool, and bespeak for them the patronage heretofore extended to us, *Page & Lockwood and E. M. Lockwood.*

E. B. BEACH & CO.

The Salamander Felting Co., 23 Dey St., New York, (Edwin H. Mulford, General Agent), have lately reduced the price of their celebrated Salamander Felting for boiler and pipe covering. It has been in use 12 years in all parts of the U. S., giving the best satisfaction.

BOILER MAKERS SUPPLIES. Trade is increasing for good material. No change in prices, which have been very low for some months.

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CONSISTING OF

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Surface Filing.
True Vise Filing,
Stove Plate and
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NOTE.—Our "Treatise on Files and Rasps" (price $1.50) will be furnished our customers free with first goods sent them.

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FOR SETTING

STEAM BOILERS.

Economy of Fuel, with increased capacity of Steam Power.

The same principle as the SIEMANS' PROCESS OF MAKING STEEL *i. e.*, utilizing the waste gases with hot air.

Will burn all kinds of waste fuel without a blast, including screenings, wet peat, wet hops, sawdust, logwood chips, horse manure, &c.

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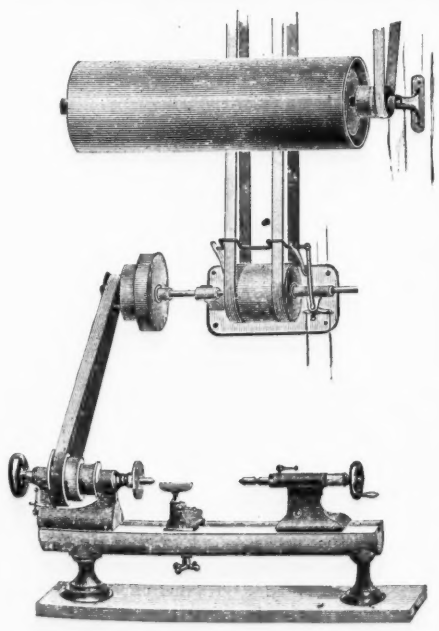

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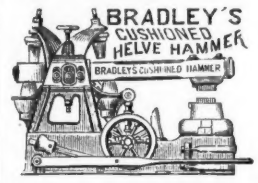
Special Tools and Machinery of all kinds.

The accompanying cut shows our No. 3, or Machinist Bench Lathe, with its driving counters for lathe, and its grinding attachments. This lathe was originally designed for the American Watch Co., and has been adopted by all American watch companies and by many clock companies of this country, and watch companies of England and Switzerland. All agree in pronouncing it the best Lathe for small work ever made.



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IT HAS MORE GOOD POINTS,
LESS COMPLICATION,
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DOES MORE AND BETTER WORK,
TAKES LESS POWER,
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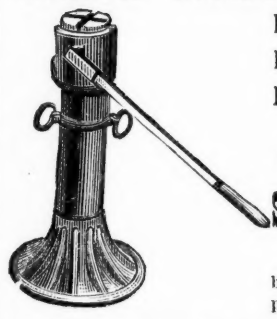

Punches, and Roller Tube Expanders,

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DIRECT ACTING

Steam Hammers.

Communications by letter will receive prompt attention.

Jacks for Pressing on Car Wheels or Crank Pins made to order.

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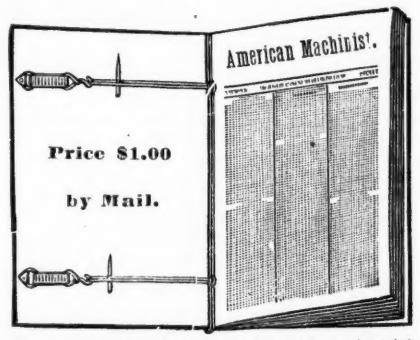

We are now prepared to offer to our readers who wish to preserve files of the paper the **MONITOR BINDER,** shown in the above cut which we have selected as the best one offered to the public. The price for neat cloth covers, to hold 24 numbers (2 years), with the name **American Machinist** stamped on the front (outside), will be $1.00 each, mailed post paid in the United States and Canada, and 75 cents each delivered at our office, 75 Fulton Street.

MILLER & BAILEY,
Editors and Proprietors.

Newell's Patent Universal Grinder.

IMPORTANT TO MILLERS, MINERS AND MANUFACTURERS.

This Grinder is offered to the public as a machine which has no equal for grinding grain or pulverizing quartz, phosphates, bone, cement, oyster shells, scraps, glue, fire clay, and other articles of similar nature. It is unrivaled in the amount of work it will do in any given time and in the economy of power used. It is a point of great merit that our mill delivers a perfectly ***GRANULATED*** article. In grinding grain the meal ***IS NOT HEATED,*** and consequently may be bagged at the delivery spout with no danger of fermentation, and without the loss of weight incidental to the product when heated in grinding. It is estimated that the usual shrinkage is sufficient to cover the entire expense of grinding by this mill. We have ground, bolted for fine feed, through 13 mesh, weighed and bagged up ***six thousand five hundred (6500) pounds of corn per hour*** with not more than 15-horse power. It is compact, portable and not expensive. A cordial invitation is extended to all parties to call and see the machine at work at

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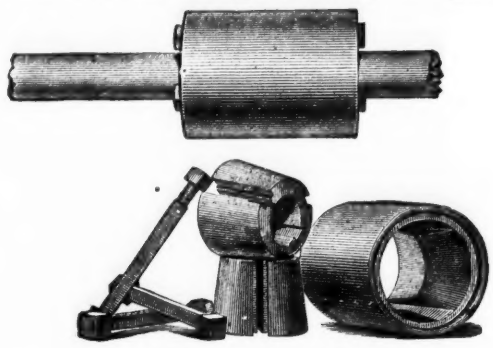

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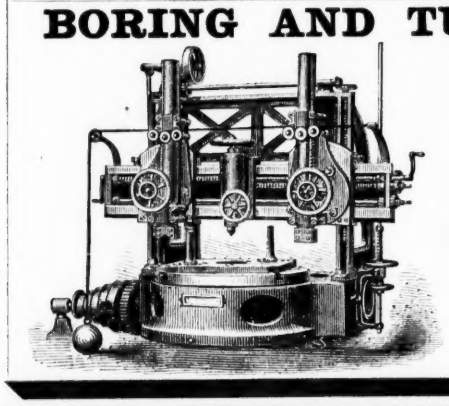

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Concentrated Power
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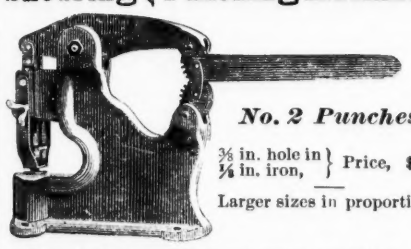

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Larger sizes in proportion.

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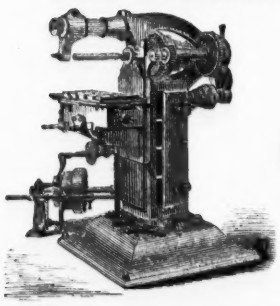

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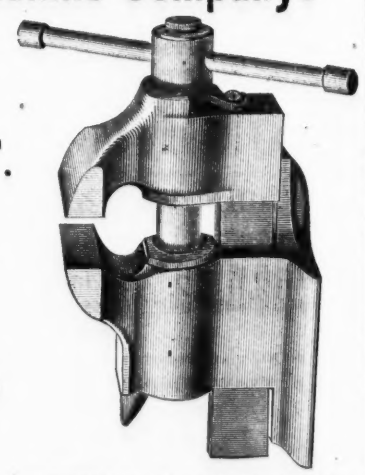

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A new Vise of extra nice workmanship The Steel Bar gives Great Strength, Great Elasticity, Great Tenacity.

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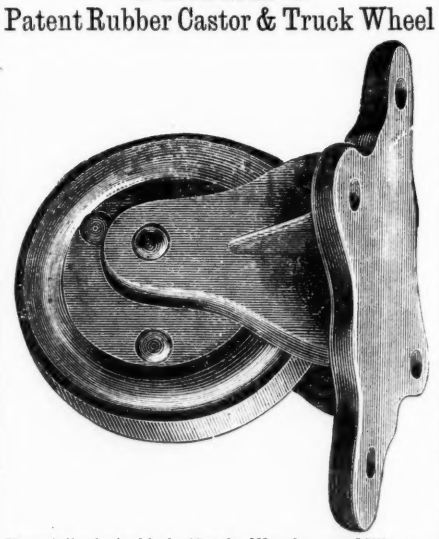

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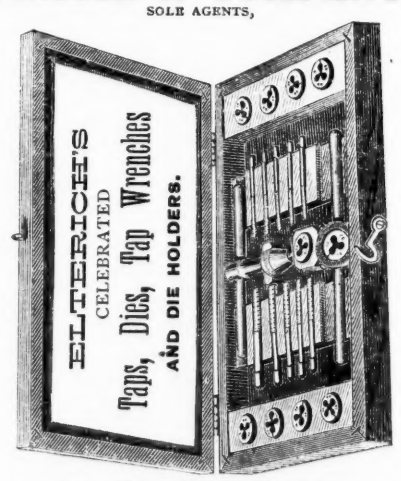

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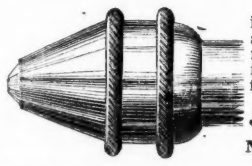

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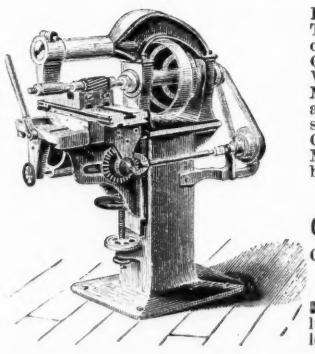

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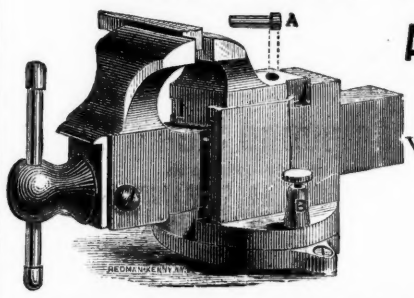

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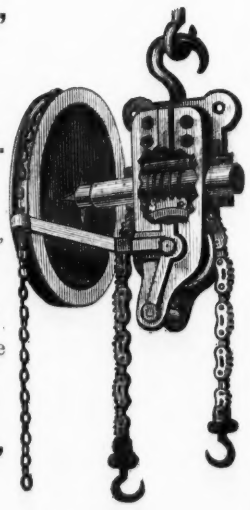

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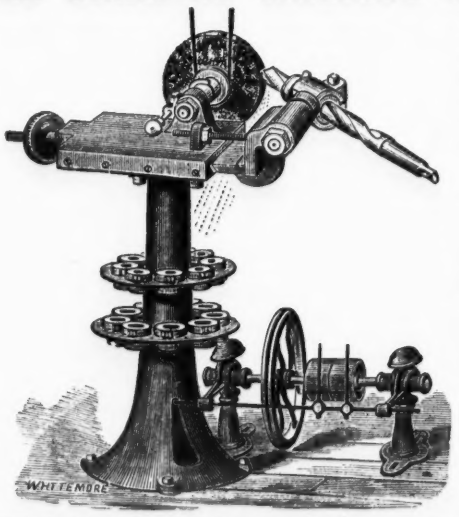
☞ Requires no skilled workman to run this machine. Either Crooked or straight drills ground quickly and accurately.



This Machine grinds drills to the same shape as the best machinists do by hand. It enables the operator to make the cutting edge or lip of the drill thick and strong so it will not crumble away in drilling, also to make the lip true with the twist or outside surface

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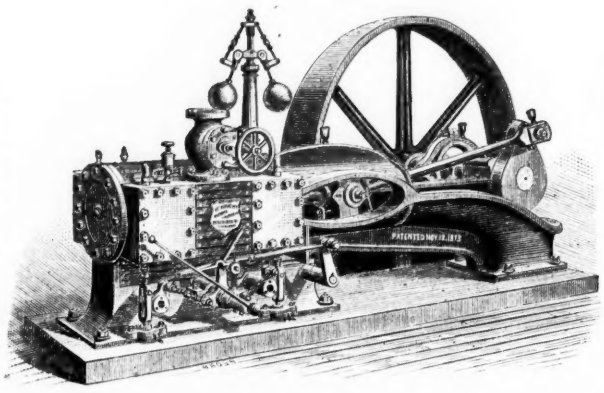

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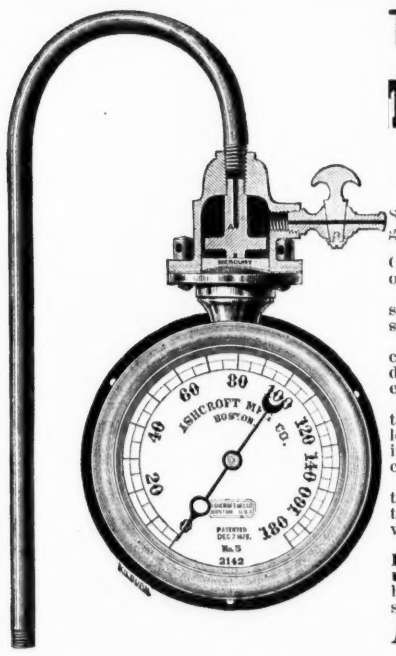

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MANUFACTURED BY

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This objection to the use of gauges whose springs are covered by rubber diaphragms is now entirely removed, the diaphragm being protected with **Mercury**, which prevents either steam or water coming in contact with it.

☞The cock shown in the cut can be used to blow out from the siphon and pipe leading to the Boiler any dirt or sediment lodging in them, and in cold weather, when the gauge is not in use, the water in the gague, siphon and pipe can be discharged to prevent freezing.

Through the orifice at A, shown in the cut, the pressure from the boiler enters the gauge at a right angle with the line of the siphon, which prevents displacement of the mercury when the cock is opened.

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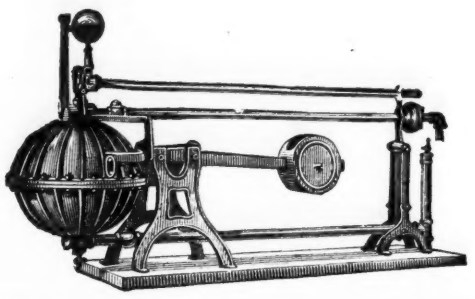

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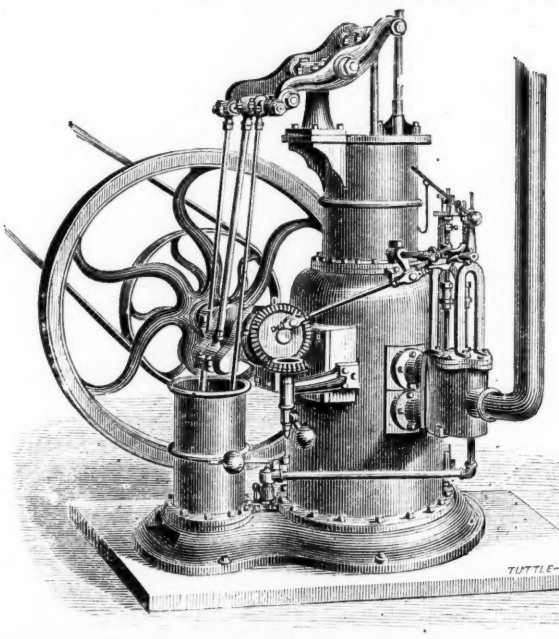

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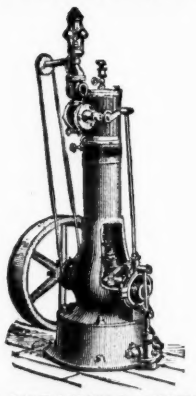

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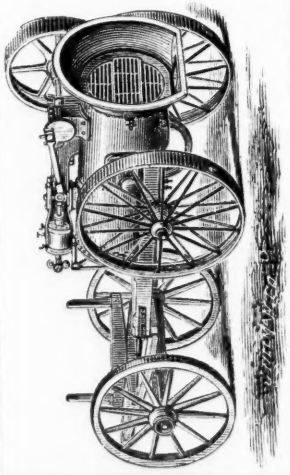

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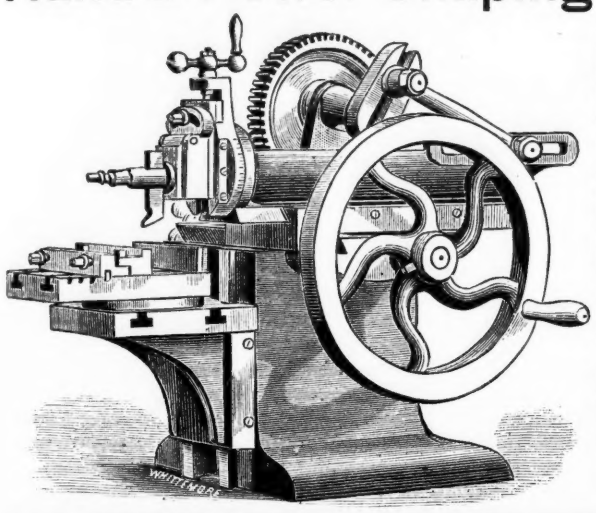

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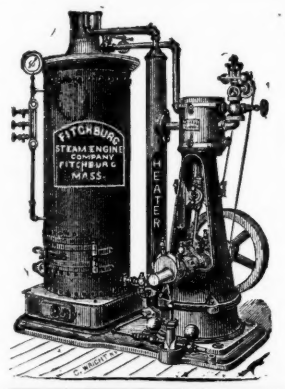

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One Engine Lathe, 21 in swing 6 ft. bed.
One Engine Lathe, 21 in. swing 16 ft. bed
One Engine Lathe 24 in, swing 12 ft. bed.
One Engine Lathe, 28 in. swing 12 ft. bed,
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One Planer, 37 in. x 37 in. x 10 ft.
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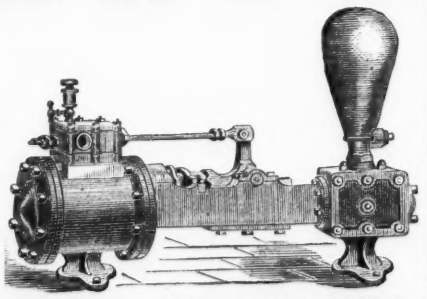

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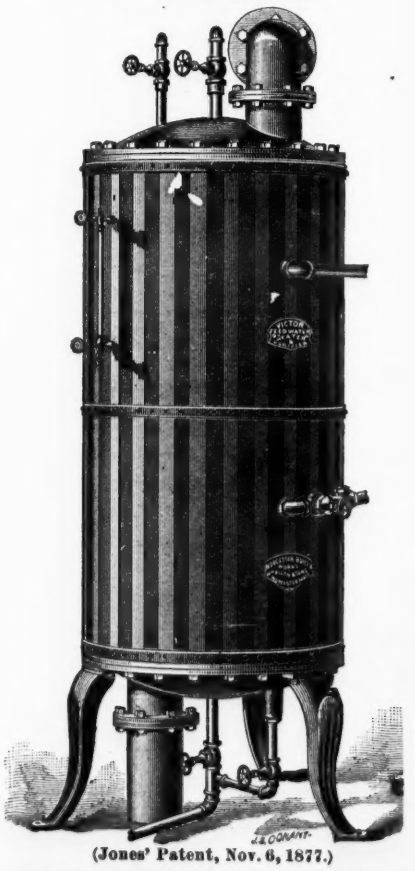

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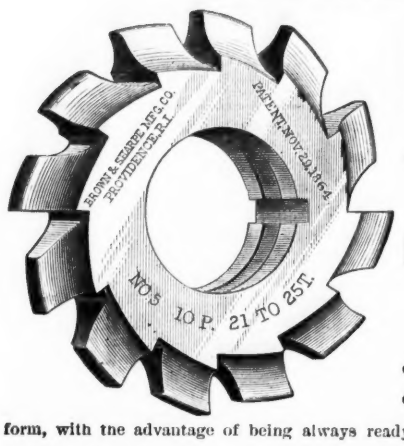

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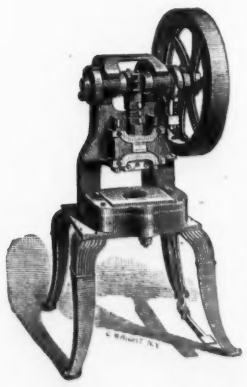

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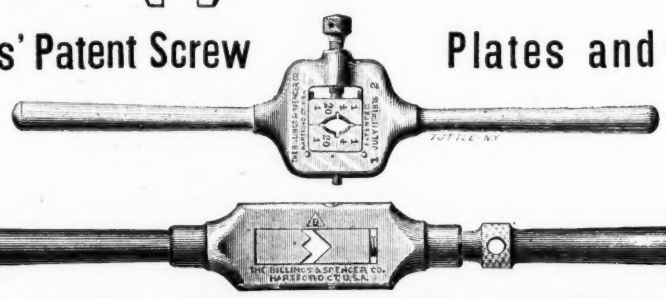

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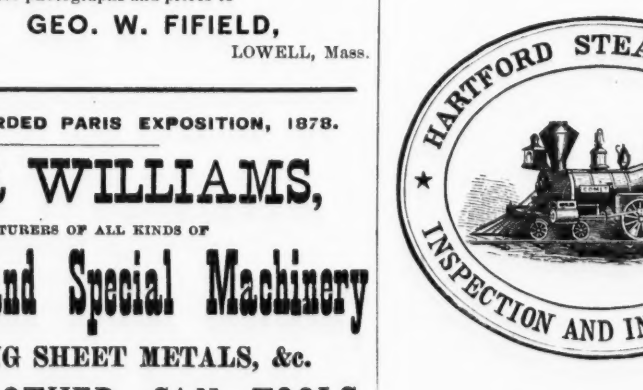

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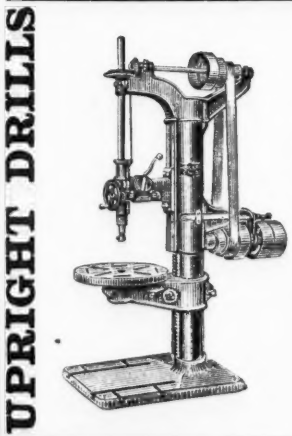

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